Parameter Generation and Control, Inc.
Black Mountain, North Carolina

(828) 669-8717

500-1000 CFM Air Handler
460V, 60 Hz

Model #9354-4250

Installation and Operation Manual

Customer _____.

Serial # _____.

Ship Date _____.

Parameter Generation and Control, Inc.
P. O. Box 129 1054 Old US 70 West Black Mountain, NC 28711
(800) 438-5494 (828) 669-6928 FAX

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Inspection

If the equipment is damaged upon receipt, immediately request the delivering carrier to perform an inspection and prepare a report. All claims for damage must be made against the delivering carrier. Report the nature and extent of the damage to **PGC, 828-669-8717**, and include instrument serial and catalog numbers to facilitate repair or replacement.

Installation

The 500-1000 CFM Conditioner was designed to be located adjacent to or on top of the chamber to be conditioned. Allow at least 36 inches on the right side and front of the unit for service. The location must be convenient to an adequate process water supply, drains and electrical power. The conditioner must be reasonably level for proper water level control.

Electrical power and water must be connected to this unit prior to operation. The required voltage and current are listed on the nameplate located on the unit. The sump drain may be connected directly to a facility drain, but the condensate drain must be connected to an open (vented) trapped drain (see Figure 3) to ensure that backpressure on the facilities' drain does not prevent proper drainage.

Note The condensate drain has been supplied with a copper trap.

Plumbing

CAUTION To prevent damage to the water pump and water heater, the unit must not be operated until water is supplied to the unit and the sump has filled to the proper level.

Process Water Supply Specifications

	Units	Maximum	Typical	Minimum
Process Water Pressure	PSIG (Bar)	**125 (8.6)**	**N/A**	**5 (0.35)**
Process Water Daily Consumption	Gallons (Liters)	**5.0 (19)**	**1.5 (5.7)**	**0 (0)**
Condensate Production per Day	Gallons (Liters)	**5.0 (19)**	**1.5 (5.7)**	**0 (0)**
Sump Water Volume	Gallons (Liters)	**15 (57)**	**15 (57)**	**6.6 (25)**

Process Water Inlet

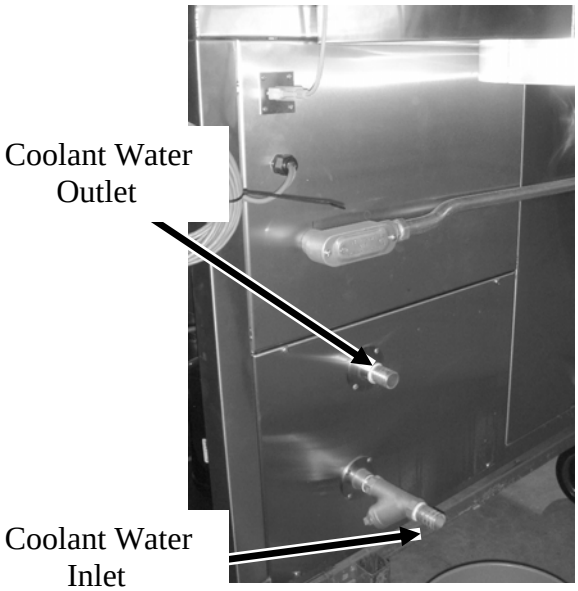
Connect a clean water supply line through an external customer-supplied hand valve to the Process Water Inlet connection on the rear of the conditioner; this is a ½" male NPT connection.

Condensate Drain
Connect the condensate drain to an open (vented) trapped external drain. This drain is a ¾" female copper sweat connection on the rear of the conditioner.

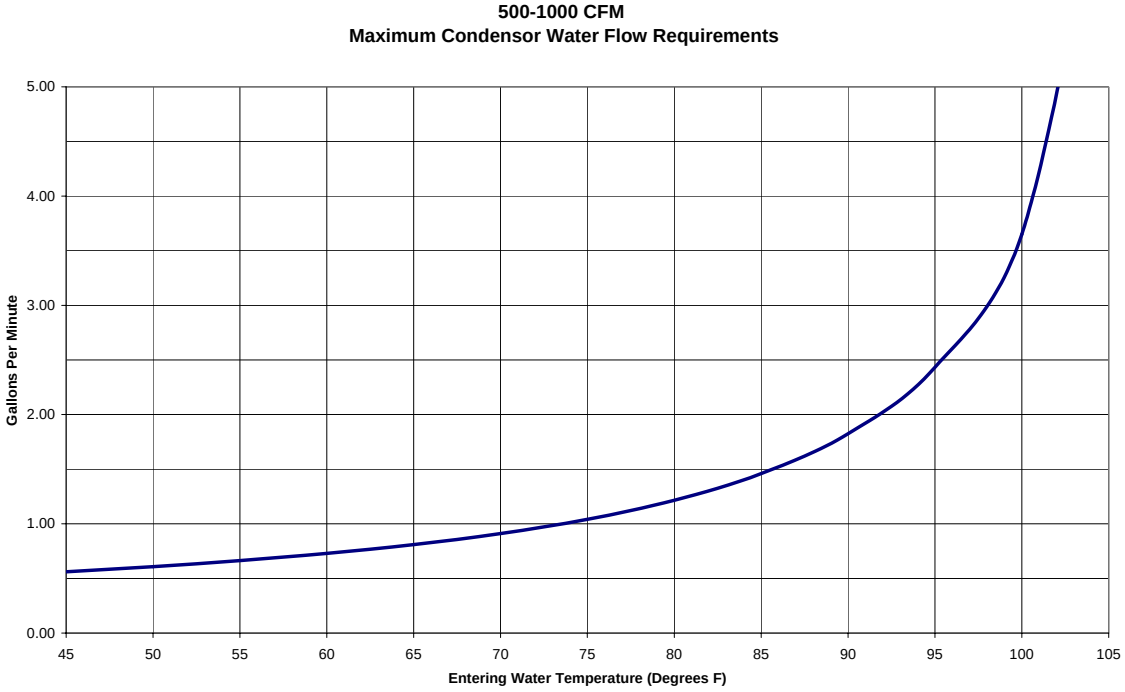
Sump Drain
Connect the sump drain to a facilities drain. This drain does not require a trap. This drain connection is made to the ¾" ¼ turn ball valve, supplied on the rear of the conditioner.

Coolant Water Supply and Return
If the refrigeration system is equipped with a water-cooled condenser. Connect coolant water to the condenser inlet connection on the rear of the chamber cabinet. Connect the coolant water return line to the coolant water outlet connection.

Coolant flow requirements will vary based on the operating conditions of condensing units, as the temperature of the coolant fluid. The following graph indicates the maximum coolant flow requirements for the condenser.



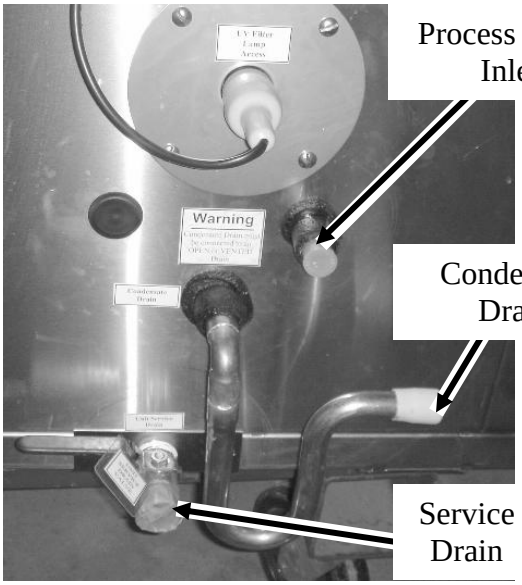
Coolant Water Connections
500-1000 CFM



Filling the sump

To fill the conditioner with water, ensure that the sump drain valve is closed and open the customer-supplied external water inlet valve. When the sump is filled to the proper level, a mechanical float valve will automatically shut off the flow and maintain the proper water level during operation. The float valve is preset at the factory to maintain the proper level (1/2" above the evaporator tubing); to change the water level, adjust the angle of the float arm slightly.

A low-water safety switch is located in the front, left corner of the sump. This switch will open when the water level is too low for safe operation of the pump and water heater. When the water level is correct, the float switch will close and allow the controller to resume operation of the unit.

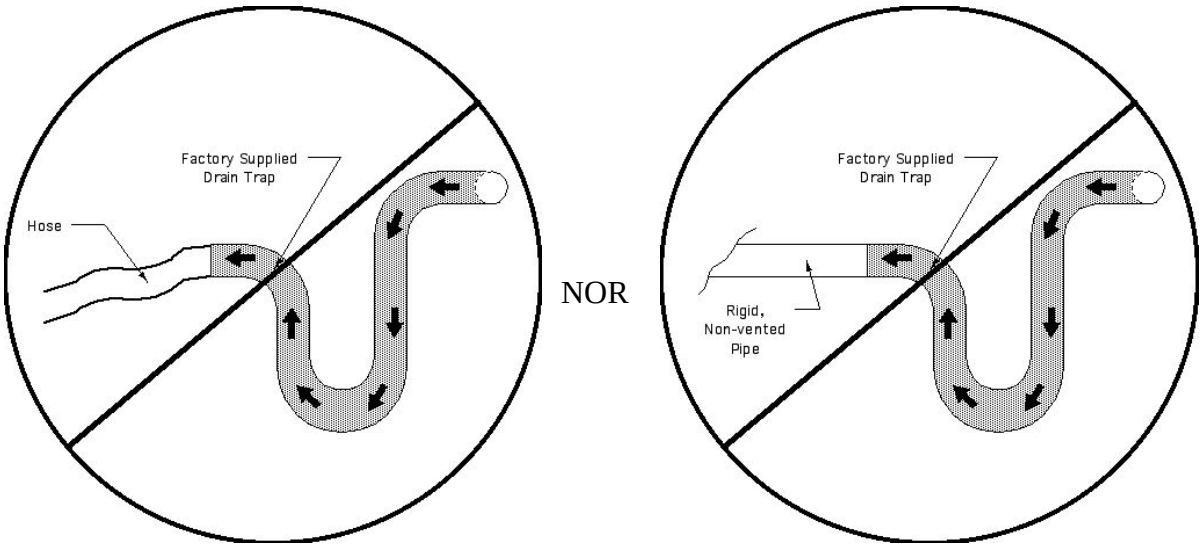


Plumbing Connections

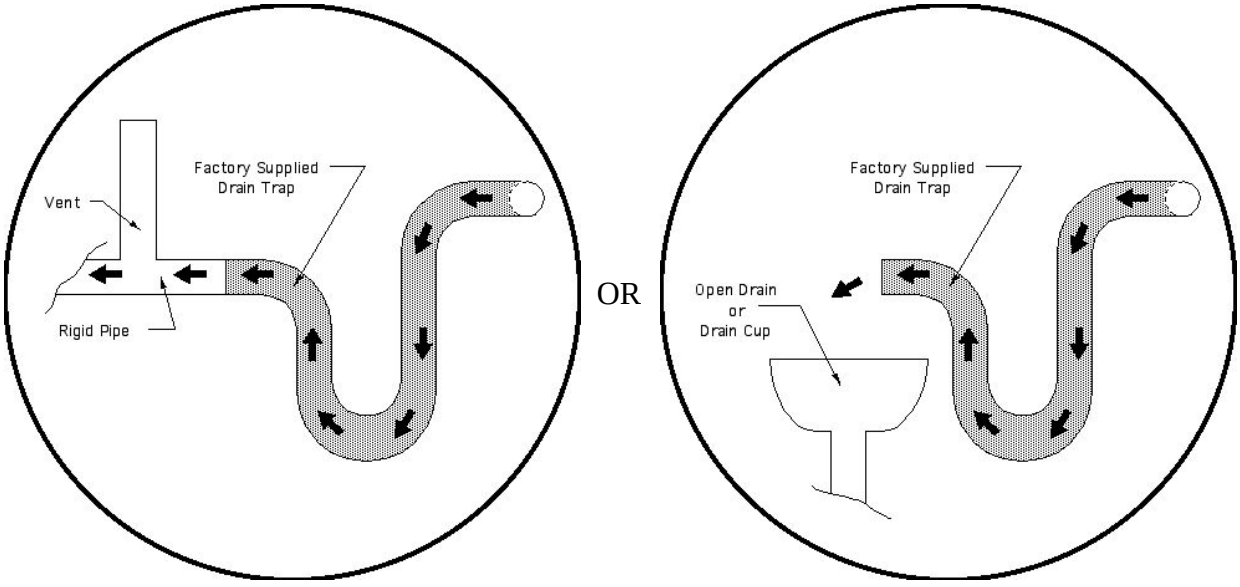
CAUTION The water fill valve float may be padded to prevent damage during shipping. Remove the padding before connecting the water supply to the inlet.

NOTE The conditioner will not operate until the low water level safety is satisfied.

CAUTION	Do not connect the drain connection to an un-vented drain.



Ensure that the drain connection is vented, as shown below.



"Open" (Vented) Drain Connections

Electrical Connections

CAUTION Turn all electrical switches, circuit breakers, and motor starter protectors (MSPs) off to prevent accidental starting of equipment when power is connected.

NOTE Determine voltage and current requirements of equipment before making electrical connections. This information is on a data plate attached to the machine.

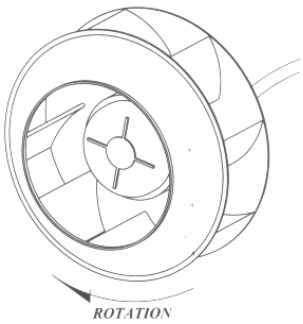
Connect the air handler in accordance with all applicable codes, using a customer-supplied disconnect device.

The SmartPad™ user interface and the optional circular chart recorder can be located remote from the air handler. Typically, the controller is located on the front of the chamber to be controlled. These components are usually disconnected for shipment and must be re-connected prior to operation. Refer to the attached wiring diagrams for re-connection information.

NOTE The SmartPad™ user interface interconnect cable has a maximum voltage of 24VDC. Refer to local codes to determine the proper conduit requirements for the control cable.

The optional circular chart recorder can be powered by 24VDC or 120/230VAC. Refer to the wiring diagrams or the data plate on the recorder for more information.

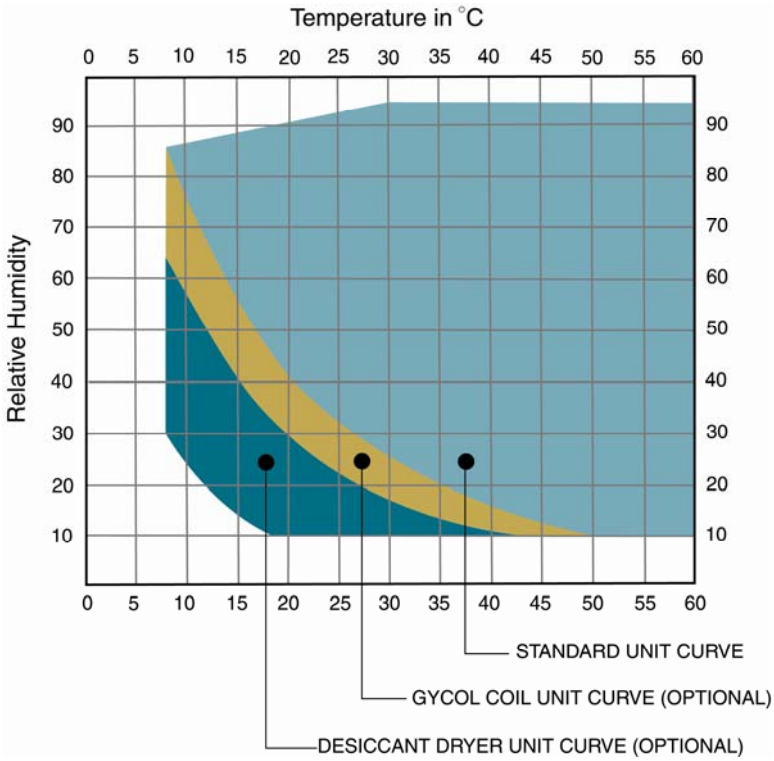
CAUTION The compressor and blower will not operate properly and may be damaged if permitted to run backward. After the Conditioner has filled with water and is operating, observe the rotation of the blower through the air bypass damper. Ensure that the blower is turning as indicated in the diagram below. If necessary, turn off the wall disconnect and interchanging any two phase wires <u>at the wall disconnect</u> or of <u>the line connection terminals</u>. *Exchanging phases at this point will reverse the rotation of all 3-phase motors.*



Operation

The 500-1000 CFM Conditioner is a self-contained conditioner designed to control dry-bulb temperatures over a range of 7°C - 60°C (44.6ºF - 140ºF), dependent upon the size and construction of the test chamber. The dry-bulb temperature is held to ± 0.2°C and relative humidity constancy to ± 0.5% with dew points above 5°C (41°F).

The SmartPad™ may be remotely mounted; refer to the PGC SmartPad™ section at the rear of this manual for instructions.


Temperature in °C
0 5 10 15 20 25 30 35 40 45 50 55 60
Relative Humidity
90 80 70 60 50 40 30 20 10
STANDARD UNIT CURVE
GYCOL COIL UNIT CURVE (OPTIONAL)
DESICCANT DRYER UNIT CURVE (OPTIONAL)

Operating Range

Turning the Chamber Off and On

When the chamber is energized and the Standby key has been pressed, the system should begin to operate and control the temperature and humidity in the chamber at the set points entered into the SmartPad™ user interface.

The SmartPad™ user interface is configured with a Standby key located in the lower right corner of the keypad. Pressing this key will disable the system and place the controller in a Standby mode. The SmartPad™ display will indicate:

STANDBY MODE

Press the ON/OFF key to energize the system

When the system is in Standby mode, it can be energized by pressing the Standby key

Process Variable Display

The Process Variable screen is the first screen that will be displayed when the conditioner is energized. This screen will display the measured process variables and will allow access to the other screens in the SmartPad™.

The bottom line of the SmartPad™ display is a label for the four function keys on the key pad. This label will vary from screen to screen to reflect the action of each of the function keys.

Refer to the SmartPad™ manual in the appendix for a complete listing and discussion of available screens.

Adjusting Set Points

In the Process Variable screen, pressing the **SP** function key will access the Set Point screen. The Set Point screen will allow the user to enter the desired air temperature and relative humidity set points for the chamber.

NOTE The SmartPad™ has no ENTER key. In order to enter a value in any field all digits must be entered. For example, to enter 25.0°C air set point you must press “2”, “5” and “0”. When the field has been filled and the data has been entered, the cursor will jump back to the beginning of the field.

Operation After Loss of Power

If power is removed from the conditioner, the controller will resume operation in the same mode when power is regained. For instance, if the SmartPad™ was in Standby mode when power was lost, it will be in Standby mode when power is restored. If the SmartPad™ was operating and controlling the chamber, it will return to that mode of operation.

The SmartPad™ is not equipped with a battery backup.

NOTE

All set points, tuning values and ramping profiles are stored in non-volatile memory and will be permanently stored in the SmartPad™.

If power is removed from the controller it will resume operation when power is restored.

In **Steady State** set point mode the controller will resume operation at the previous steady state set points.

In **Programmable** set point mode the controller will resume operation at exactly the same segment and time remaining in that segment ***if the duration of the power loss is less than approximately 20 minutes***. ***If the duration of the power loss exceeds approximately 30 minutes*** the controller will re-initiate the program according to the loop parameters defined in the **INIT** screen.

Fault Displays

If the system encounters a temperature, low-water, remote on/off switch, or refrigerant pressure fault, the system will shut down and the SmartPad™ will indicate the fault that has occurred. The SmartPad™ will continue to indicate that the fault exists, and will indicate if/when the fault has cleared.

If the fault has been cleared, the system can be re-energized by pressing the Standby key . If the fault has not cleared, the source of the fault must be determined and corrected before the system can be re-energized.

Some faults will clear automatically and others will require user intervention.

NOTE

Regardless of the fault clearing mechanism, the user must press the Standby key in order for the conditioner to resume operation.

Control Modes

The PGC conditioning system offers four modes of temperature and humidity control.

1. **Cascade Temperature Mode**
   This is the most commonly used mode because the user specifies only the desired air temperature and relative humidity (Rh) level in the chamber. The temperature of the water spray controls the dew point of the discharge air and the water temperature is adjusted in order to achieve desired humidity level. The air is then re-heated to the desired temperature before returning to the test chamber. This allows the system to respond to load variations while retaining the basic stability of a spray system.

2. **Two-Temperature Mode**
   In this mode, the user establishes the desired air and water temperatures that are required to produce the desired relative humidity level, as determined by a psychometric chart. The Two-Temperature mode can be used when operating the very edges of the system capabilities.

3. **Slow Damper Mode**
   This mode is similar to Cascade mode with the difference being that the air bypass damper control loop and the air heater control loop have been separated. In this mode the damper is moved slowly and its final position is when the desired percentage of air heat output is achieved. The desired percentage of air heat is determined by the user in the tuning parameters (Manual Adjust) section of the controller. In some situations, slow damper mode can be applied to improve energy efficiency or extend the operating range of the system. Typically, slow damper mode is most effective when the system is operated at a single condition as it will often require manual tuning adjustments for proper operation at multiple set points.

4. **Dry Mode**
   This mode is required to control dew points below 4°C. In this mode, all water is removed from the spray chamber and an optional desiccant dryer is used to control humidity. Although this mode is accessible in SmartPad, it is non-functional unless the system is equipped with a desiccant dryer.

Specifications, 500-1000 CFM

Voltage---------- 460V~
Frequency----------3ph, 60 hertz
Current ---------- 8.8 FLA
Circuit Capacity (Max / Min) ----------30A / 12A
Heater, Water ---------- 1800 watts
Heater, Air (Two, 1500 watt) ---------- 3000 watts
Refrigerant----------R-404a, 96 Ounces.
Process Water Pressure, (Max/Min) ----------125/5 psig
Weight Net ----------1000 lb.
Weight Shipping----------1400 lb.
Temperature Range ----------7° to 60°C
Relative Humidity Range----------10% to 95%[1]
Temperature Constancy (control) ---------- ± 0.2°C
Rh Constancy (control) ----------± 0.5%

[1] Minimum Rh is limited by a minimum dew point of 5°C (41°F) for standard Spray Mode. For example:

Air Temperature	Max. Rh	Min. Rh
10°C (50°F)	88%	70%
25°C (77°F)	93%	32%
40°C (104°F)	95%	17%
> 50°C (122°F)	95%	10%

Replacement Parts, 500-1000 CFM

Description	Mfg. / Supplier	Mfg./Supplier #	PGC #
ACE Master Micro Controller	PGC	ACE 503g	N/A
ACE4 Controller Assy.	PGC	OEM	6000-1559
ACE4 Power Supply	Meanwell	PS45-24	1607-0024
Circuit Breaker,1 Pole, 2AMP	Siemens	5SX2102-8	0426-1020
Circuit Breaker,2 Pole, 2AMP	Siemens	5SX2202-8	0426-2020
Compressor	Copeland	CS14K6E-TFD-230	1510-0298
Contactor	Siemens	3RT1025-1BB40	0419-0948
Damper Drive Motor Actuator	Belimo	OEM	1608-0916A
Door, Spray Chamber, Inner	PGC	N/A	6000-0303
Door, Spray Chamber, Outer	PGC	N/A	6000-0392
Evaporator Coil, 5/8 OD x .032 wall	Super Radiator Co.	OEM	1244-0066
Filter Bag,5 Micron, Polyester	McMaster-Carr	9316T22	0215-1800
Fuse, Door Heat 5A	Bussman	FNM5	0409-0123
Gasket, Return Duct Transition Box, 140”	Refrig. Hardware	47-131	1604-0101
Gasket, Spray Chamber Inner Door, 95”	Refrig. Hardware	47-131	1604-0101
Gasket, Spray Chamber Outer Door, 95”	Refrig. Hardware	47-131	1604-0101
Gasket, Supply Duct Transition Box	Refrig. Hardware	47-131	1604-0101
Heater, Air	Vulcan	OEM	0416-0508
Heater, Water	Watlow	OEM	0416-0599
Hour meter, UV	Durant	E42DIR48230	0215-2821
HygroClip Connector and Cable, 5 meters, amplified analog, 0ºC to 100ºC	PGC	MOK-05-XX-005V-1-DIO	1636-0159
HygroClip Micro Controller	PGC	Hygro 503	N/A
HygroClip T/Rh Transmitter, Full-Range Calibration	PGC	OEM	1608-0865b
HygroClip T/Rh Transmitter, Single-Point Calibration	PGC	OEM	1608-0865a
HygroClip T/Rh Transmitter, Un-calibrated	Rotronic	HygroClip S	1608-0865
HygroPalm Calibration Cable	PGC	AC1620-modified	1609-0866
HygroPalm Calibrator	Rotronic	HygroPalm 2	1609-0865
Latches, Access Panel	Southco	62-43-251-3	1008-0080
Latches, Inner Doors	Southco	OEM	1001-0082
Latches, Outer Doors	McMaster-Carr	5481K19	1009-1017
Mist Eliminator	PGC	N/A	5000-0135
Motor Protector	Siemens	3RV1021-1KA10	0427-1250
Motor Protector	Siemens	3RV1021-0GA10	0427-0063

Description	Mfg. / Supplier	Mfg./Supplier #	PGC #
Motor Protector	Siemens	3RV1021-1BA10	0427-0200
Motor, Blower	Continental Fan	RO-TMK280-2-34	1602-0199
Pump	March	TE5.5CMD	1619-0091
Refrigeration Dryer, Filter	Sporlan	CW-165S	0215-0887
Relay , Solid State, Door Heat	Omron	G3NE-210T-US	0416-0414
Relay, Solid State, 4-28 VDC	Continental	RVDC/6V25	0416-0403
Sensor , Door Jamb Temperature	JMS Southeast	OEM	1607-0652
Sensor ,Water Temperature	JMS Southeast	3ESCK6BZZ3120JYTA	1619-0862
SmartPad™ controller	PGC	OEM	1607-1100
SmartPad™ Micro Controller	PGC	Spad 503D	N/A
Spray Nozzle	Spraying System	NO. 1/4A-SS5-15.	1612-0201
Stepper Micro Controller	PGC	Step 503 (SDR3)	N/A
Strainer, Bronze “Y”	McMaster-Carr	43935K24	0215-0904
Supply Duct Transition, 10” Round	PGC	N/A	5000-1389
Surge Suppressor	Siemens	3RT1936-1TR00	0419-0891
Switch, Float	Gems	LS1750-192-908	0421-0060
Switch, Hi-Lo Refrig Pressure	Copeland	085-CP2M-7K	0423-0683
Thermostat, Safety	Thermtrol	TS-120SR 30F-240F	1636-0223
Timer, Chamber Light	Intermatic	FF60MC	0419-0355
Transformer	Micron	B100MBT713XK	0419-0326
UV Lamp	Severn Trent Water	5340UD	0215-2825
UV Lamp Power Supply	Severn Trent Water	20697UD	0215-2831
UV Lamp Quartz jacket	Severn Trent Water	2450UD	0215-2824
UV Plastic Support	PGC	OEM	0215-2826
Valve, Expansion, Body	Danfoss	068U2287	0215-0872
Valve, Expansion, Cartridge	Danfoss	068U1037	0215-0777
Valve, Hot Gas Temp Control	Sporlan	SDR-3-20-S	0215-0873
Valve, Sump Float	Hawkeye Steel Products	UFV600	0209-0050

Notes:

www.humiditycontrol.com (800) 438-5494
sales@humiditycontrol.com Fax (828) 669-6928 (828) 669-8717
Black Mountain, North Carolina

Appendix A

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SYSTEM CONSTRUCTION

The 500-1000 CFM Conditioner consists of four main sections:

1. **Conditioning Compartment**: spray bypass damper, blower, spray eliminators, spray jets, water sump, low water level safety float switch, process water float valve, stirring jet, evaporator coil, and particulate filter
2. **Mechanical Compartment** (side access panels): refrigeration condenser, compressor, receiver, , high- and low-pressure safety switches, filter/dryer, hot gas bypass valve, water pump, water heater, water RTD, Programmable Logic Controller (PLC), and power panel with terminal strips, circuit breakers, motor starter, and contactors
3. **Conditioner Exterior**: sump drain valve, air bypass damper actuator, UV filter, and air temperature safety thermostat.
4. **Control Enclosure**: SmartPad™ user interface and optional chart recorder.

The unit is sturdily constructed, with a stainless steel interior and exterior, and insulated door with heavy refrigerator-type latches and vapor-resistant seals. Double walls separated by insulation are used around the conditioning chamber. All internal seams are welded to preclude saturation of the insulation.

The spray tree is a 3" stainless steel tube (spray header) with spray nozzles attached along the sides, and a clamp on each end for sealing the tube. The clamp on the right end secures a blank plate against an O-ring gasket. A UV lamp is inserted from the electrical compartment, through the plate on the left end.

THEORY OF OPERATION

PGC's method of control is the same for both reach-in chambers and conditioning systems. The environment to be conditioned is controlled at a targeted dew point temperature, and then reheated to the desired air temperature. This methodology follows a proven technique that maintaining a constant dew point and air temperature will produce a very constant relative humidity. The desired air temperature and relative humidity or water temperature are set via the SmartPad™. If equipped with an optional recorder, it can be wired to record the actual air temperature and relative humidity or water temperature.

The air is cooled by means of a water spray which constantly sprays water across the air stream, saturating the air. A submerged refrigeration evaporator coil operates 1°C-2ºC (1.8°F-3.6°F) below the desired dew point and cools the water that is sprayed across the air stream. The air is then re-heated before it is returned to the test chamber.

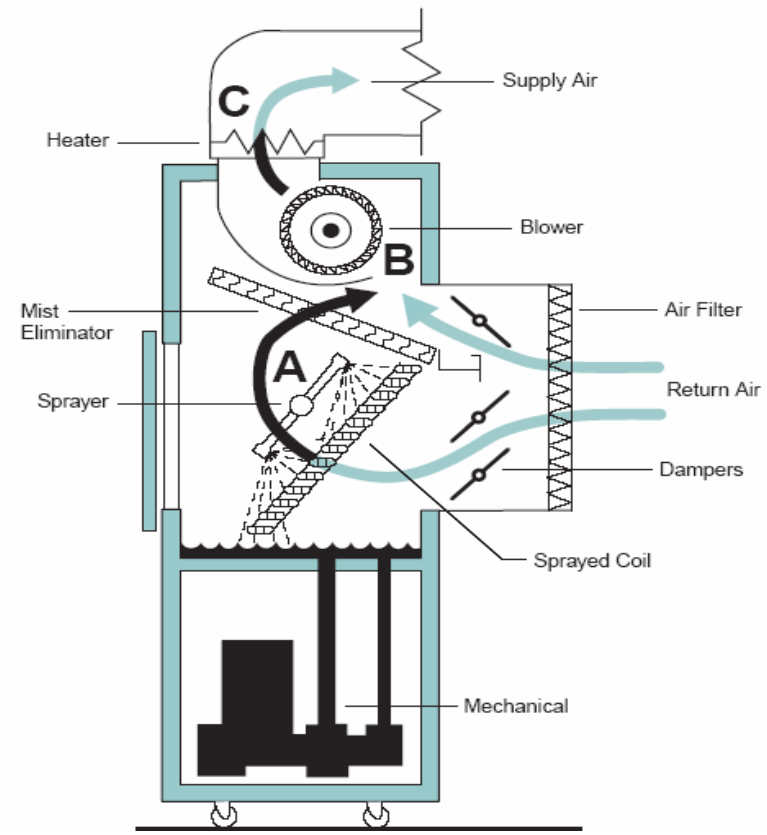


Figure A-1 - Generic Conditioning Unit

NOTE Dew point is the temperature at which the air can contain no more moisture and some moisture begins to condense.

A portion of the air can be diverted around the water spray saturator by a bypass damper. If the air does not pass through the water spray, it will not be cooled; if the air is not cooled, it will not require as much (if any) air heat to be applied before it is returned to the test chamber. The amount of air that passes through the saturator, or bypasses the saturator, is determined by the air temperature control loop.

DESCRIPTION OF OPERATION

The 500-1000 CFM Conditioner is a self-contained conditioner designed to control dry-bulb temperatures over a range of 7°C – 60°C (44.6ºF - 140ºF), dependent upon the size and construction of the test chamber. The dry-bulb temperature is held to ± 0.2°C and relative humidity constancy to ± 0.5% with dew points above 5°C (41°F).

The temperature of the water spray saturator controls the dew point of the discharge air. When in Rh Cascade or Slow Damper mode, the water temperature in the saturator is varied slowly in response to a humidity control system. This allows the system to respond to wide load variations while retaining the basic stability of a spray system. When in Two-Temperature mode, the user establishes the air and water temperatures.

MEASUREMENT OF TEST CHAMBER CONDITIONS

Precise control of temperature and humidity within the test chamber is obtained by accurately measuring the dry-bulb temperature and the dew point temperature of the air in the test chamber or the duct. The temperature of the water in the spray chamber controls the dew point temperature, and is measured prior to the spray nozzles.

When operating in one of the spray modes, the dew point of the air exceeds the water temperature by approximately 1°C for each 10°C difference between the air and water temperatures. During the ramp portion of program cycling, the dynamic heat exchange process that takes place makes it difficult to establish any exact relationship. When operating in the Two-Temperature mode, refer to the air/Rh/water spray graph provided with the unit for air and water temperatures necessary for the desired relative humidity.

AIR FLOW

As the air enters the conditioner through the round, flexible duct connection in the removable top cover. The process blower, located beneath this cover, will force the air into the conditioning section. Entering the conditioning section, the air first encounters the by-pass damper; the damper determines the volume of air that enters the saturator, and the volume that is bypassed around the saturator. When the damper is fully closed, all of the air is forced through the water spray. As the air passes through the water spray, it is saturated and cooled, nearly to the water temperature. This method provides a stable dew point for the air as it leaves the saturator section. The chilled and saturated air then passes through the water droplet eliminator to remove any free moisture that may be present. The air then continues over the dry-bulb heaters, where it is heated to the desired chamber air temperature (without affecting the dew point) and is returned to the chamber through the round, flexible duct connection on the left end of the conditioner.

When the damper is fully open, most of the air bypasses the water spray and travels directly to the air heaters. The bypassed air is then mixed with any air that traveled through the saturator section and then returns to the test chamber. The spray bypass damper will be automatically positioned by the actuator operating on a control signal derived from the duty cycle of the air heater. The position of the damper can range from 0% to 100% open.

The dew point of the air stream is controlled even when most of the air is bypassed around the water spray saturator. The air bypass damper is not 100% efficient, allowing some air to enter the water spray saturator even when closed.

NOTE	In Slow Damper mode, the position of the damper is load dependent; the damper will change slowly to achieve the desired conditions. The damper will also change position in order to compensate for droop or overshoot in the air temperature control loop.

WATER FLOW

The water pump is located in the right section of the cabinet (accessible through the front or side access doors). The water is picked up by the pump and heated, and then forced across the water temperature sensor (100Ω platinum RTD) and into the spray header in the spray chamber. The spray header is situated to spray water across air stream. The remainder of the water passes through the particulate filter to remove debris.

TEMPERATURE CONTROLS

The water temperature is sensed immediately prior to entering the spray headers, and the air & humidity are measured by the HygroClip™ T/Rh transmitter that is located in the air stream.

The air heaters are positioned in the air-stream path between the chamber and the saturator. The amount of heat applied is controlled by the dry-bulb control system with the sensing element in the air stream. The duty cycle (the percentage of heat applied) for the air heater can be accessed from the SmartPad™.

The water in the sump is cooled by the refrigeration evaporator, and is then sprayed across the air stream to cool and saturate the air. Since the refrigeration system has a greater capacity than is needed for most conditions, a hot gas bypass valve is provided to modulate the refrigeration capacity as required. This valve is automatically adjusted by an actuator operating on a control signal derived from the duty cycle of the water temperature control loop; the more the hot gas valve opens, the more the refrigeration capacity is reduced. The relative position of the hot gas bypass valve is represented by the water heater output percentage: Zero (0%) out is full refrigeration capacity (hot gas bypass valve closed); one hundred percent (100%) out is minimum refrigeration capacity (hot gas bypass valve open).

There are four factors that limit or control Water Set Point:

1. **Humidity Control Band**
   Water Set Point will change in order to control Rh. If the measured Rh value is less than the Rh set point, the Water Set Point will increase in order to increase the Rh by increasing the dew point. The maximum rate at which the Water Set Point will change is adjustable; the most common Water Set Point Rate of Change is 0.25ºC/minute (the maximum value). The Water Set Point Rate of Change is proportional to the deviation from Rh Set Point. For example, if the Rh control band is +/- 10% and the measured Rh is 10% below Set Point (at 100% of the control bandwidth), the water Set Point will change at the rate of 0.25°C/minute (the maximum Rate of Change X 100%). If the measured Rh is 5% below the Rh Set Point (at 50% of the control bandwidth), the water Set Point will change at the rate of 0.125ºC/minute (the maximum rate of change X 50%).

2. Water Temperature Set Point Limits

Minimum and maximum Water Set Point limits are factory pre-set in order to prevent freezing or overheating the pump.

3. Dew Point

Humidity is a function of air temperature and dew point, and the water temperature is directly related to dew point The controller limits the Water Set Point to 1ºC < Air Set Point to prevent a runaway temperature control. Without this limit, a runaway condition could be experienced when operating the unit with a high humidity set point. Such a setting could cause the water temperature to keep increasing in order to achieve the humidity set point, which would have the side effect of increasing the air temperature; this increase in air temperature would increase the capacity of the air to hold moisture, such that the system would never reach the humidity set point.

4. Measured Water Temp

If the Rh Set Point is set above or below the current Rh control band, the Water Set Point Rate of Change will automatically maximize to change the water temperature as quickly as possible. Many variables affect how fast the water temperature will change, such as the efficiency of the pump, how much water is in the sump, how often the test chamber is opened, etc. These are beyond the capability of the control system to measure; however, the controller measures how quickly the water temperature is actually changing, regardless of the uncontrollable variables. When the measured Rh is outside of the control band, the Water Set Point is changed automatically:

Water Set Point = Measured Water Temp + Control Bandwidth

For example, assume that the unit is operating with a Water Set Point of 25ºC and the water control bandwidth is 5ºC, with the humidity controlling at 50% with the control bandwidth at 10%. If the Humidity Set Point is set above the upper level of the control band (>60%), then:

Measured Water Temperature + the Water Control Band = new Water Set Point

In this example, the new water Set Point would be (25ºC + 5ºC=) 30ºC. This will cause 100% water heater output, and the Water Set Point will continue to increase at a value equal to the rate that the water temperature is changing. As soon as the measured humidity value is back within the control band (in this example, when the measured Rh is 65.01%), the Water Set Point will resume changing at the normal rate.

DESCRIPTION OF CIRCUITRY

CAUTION Although this conditioner utilizes 24 volts DC for the control circuits, some components require 120 or 460VAC; these voltages can be present even when the conditioner is not operating.

CAUTION Power to the unit should be removed at the wall disconnect prior to opening any of the access panels.

Line voltage is applied to the 24 VDC power supply. The 24VDC power supply provides power to the Programmable Logic Controller (PLC), the HygroClip T/Rh transmitter, the air bypass damper actuator, safety devices, and the line contactor.

The PLC has an on-board DC-DC converter that will produce +5VDC for the board-level logic components. A second DC-DC converter produces +15VDC for use by the SmartPad user interface, stepper motor, and the RTD amplifiers.

When power is applied to the conditioner, and control circuit breaker(s) are closed, the SmartPad user interface will be energized. If all of the safety devices are satisfied (pressure switches, thermostats, float switches, etc.), then the conditioner can be energized by pressing the Standby key on the SmartPad™ user interface. This will instruct the PLC to energize the line contactor (1CON).

When 1CON is closed, power is applied to the motor starter protectors (MSPs) and the heater circuit breaker. If the MSPs are closed, then the compressor, blower, and pump will be energized. If the heater circuit breakers are closed, then the air and water heaters will be enabled. The operation of the air heaters and water heater is controlled by the PLC; the PLC determines the duty cycle (On time verses Off time) for each of the heaters, based on the requirements of each temperature control loop. The PLC will open and close digital outputs that will control the input signals to solid-state relays, which will apply power to the respective heater based on the respective control loop. An LED on each relay will indicate the On or Off status of that particular heater control loop.

The UV filter will also be enabled by the control circuit breaker(s). Any time power is applied to the conditioner, the control circuit breakers are closed, and the unit is operational (i.e. 1CON is closed), the UV filter should be energized.

On initial power up, the PLC will determine the hot gas bypass valve position by driving the stepper motor to fully close (0% output) the hot gas bypass valve in order to “zero” the valve. This involves driving the motor past the full closed position; the valve will be seated against the full closed stop but is not damaged by this over driving maneuver. Bumping the valve against the full-closed stop can correct for any “lost steps” or accumulated errors that could occur over time due to the constant reversal of the stepper motor.

During normal operation, the position of the hot gas valve is based on the output percentage of the water temperature control loop. This output percentage is translated into a percentage of “open” value for the stepper motor. The PLC converts this percentage open value into a step count that will position the valve accordingly. When the valve is adjusted to the desired position, the PLC will cease to step the motor, and the motor will maintain its current position.

The position of the air bypass damper is determined by the PLC based on the air output percentage. The input to the damper actuator is a frequency modulated (FM) square-wave signal. The damper will be positioned based on the frequency of the FM signal. A yellow LED on the PLC indicates the duty cycle. Zero percent (0%) air heat output will produce a 0.59 second On time pulse, which instructs the damper to move to the full spray position. One hundred percent (100%) air heat output will produce a 2.93 second On time pulse, which instructs the damper to move to the full bypass position. An On time between 0.59 seconds and 2.93 seconds will produce a proportional response in the damper position.

The water temperature is measured using a positive-coefficient 100Ω Platinum RTD temperature sensor. This sensor consists of a very thin Platinum wire that is wound around a ceramic core. As the temperature of this wire increases, the resistance of the Platinum element increases linearly. This resistance is placed in a bridge network to produce a linear voltage proportional to the change in temperature. This voltage is then converted to a digital value that can be used by the PLC by and the A/D converter.

The air temperature is also measured using a 100Ω RTD located in the HygroClip T/Rh transmitter. A circuit in the HygroClip converts this RTD input to a digital signal that is transmitted to the PLC using a single-wire serial interface. The PLC receives this digital signal and converts it to a digital value that the PLC can use in its calculations.

The HygroClip also converts the RTD input into a 0-1VDC analog signal that is scaled so that 0.1VDC = 1°C. This analog signal is applied to an amplifier built into the HygroClip connection cable, which converts the 0-1VDC signal into a 0-5VDC signal (0-5VDC is required if the analog signal is transmitted more than 10 feet). The 0-5VDC amplifier can be used to scale the analog output for different ranges; the most common range is (0-5VDC) = (0°C to 100°C). However, amplifiers are available for (-30°C to +70°C) and (-40°C to +60°C). This 0-5VDC analog amplifier is not used by the chamber controller, and is only required when an analog device (such as a chart recorder) is connected to the system. This analog output is available on the chart recorder connector of the PLC.

The relative humidity is measured using a thin-film polymer capacitive element that changes capacitance as moisture is absorbed or given off. The HygroClip T/Rh transmitter will convert this change in capacitance into a digital value. This digital value is transmitted to the PLC in the same single-line serial interface as the air temperature measurement. The PLC will decode the digital value and convert it to a digital value that can be used by the PLC. The HygroClip T/Rh transmitter will also convert the measured Rh to a 0-1VDC analog output. The same analog amplifier that is used in the analog air temperature output will convert the 0-1VDC signal to a 0-5VDC signal. In all instances, the Rh output will be scaled so that 0-5VDC will equal 0-100% Rh. This analog output is also available at the chart recorder connection on the PLC.

A separate voltage to current converter is installed in the air handler electrical compartment for both the air temperature and relative humidity. This device will convert the 0-5VDC analog signal from the HygroClip to 4-20mA. The output will be scaled so that 4-20mA corresponds to the same temperature or Rh range as the analog signal from the HygroClip (typically this will be 4-20mA = 0-100°C or 0-100% Rh). The 4-20mA signal is provided as an interface to a customer supplied monitoring device. This converter is equipped with a zero and span calibration potentiometer that can be field adjusted in order to match the 4-20mA output with the NIST traceable temperature and Rh output from the HygroClip.

SAFETY DEVICES

The unit is equipped with several safety devices to guard against serious trouble due to failure of any components.

Alarm contacts are available on the PLC, which will switch when either of the process variables is in an alarm condition. The process variables are Air and Water in Two-Temperature mode, or Air and Rh in any other mode. The alarm type, set points, and time delay are all programmable from the SmartPad™; and the alarm can be disabled from the SmartPad™; refer to the SmartPad™ manual for further information. The alarm contact is a single-pole double-throw (SPDT), Normally Open / Normally Closed, dry contact relay rated at 6 Amps @ 250VAC.

Compressor Internal Overload: The refrigeration compressor is equipped with an internal thermal protector. If the compressor draws excessive current, the motor windings will overheat. If the windings overheat, the internal thermal protector will open and the compressor will not operate. The rest of the chamber will continue to function, although it is not possible to control air or water temperature unless the compressor is operating. As soon as the internal temperature of the compressor motor drops to a safe operating level, the compressor will resume operation. This reset process will normally require about 45 minutes.

Several potential causes of a compressor internal overload include the loss of coolant water flow, excessive coolant water temperature, clogged coolant water inlet filter, high ambient temperature, or excessive refrigerant charge, low line voltage, or unusually high ambient temperature.

Refrigeration High Pressure Fault: A pressure switch monitors the discharge pressure in the refrigeration system. This switch is located beside the compressor. If the pressure is allowed to operate at an excessive level, the compressor will be damaged. If the high-pressure switch opens, the SmartPad™ will pad indicate “HIGH PRESSURE FAULT SET” and the system will shut down. The high-pressure switch will automatically reset after the refrigeration discharge pressure falls below the pressure trip point. When the switch is reset, the SmartPad™ display will indicate “HIGH PRESSURE FAULT CLEAR”, and the system may be restarted by pressing the Standby key on the SmartPad™ key

Several potential causes of a compressor internal overload include obstructed or dirty air cooled condenser, excessive refrigerant charge, low line voltage, or unusually high ambient temperature.

Refrigeration Low Pressure Fault A pressure switch monitors the suction pressure in the refrigeration system. If this pressure is allowed to operate below a safe level, the compressor may be damaged. If the low-pressure switch opens, the SmartPad™ will indicate “LOW PRESSURE FAULT SET” and the system will shut down. The low-pressure fault will automatically reset when the refrigeration suction pressure rises above the pressure trip point; when this occurs, the SmartPad™ display will indicate “LOW PRESSURE FAULT CLEAR”, and the system may be restarted by pressing the Standby key on the SmartPad™ key pad.

Some potential causes of a low-pressure fault include, but are not limited to, low refrigerant charge, frozen evaporator, or a poor spray pattern.

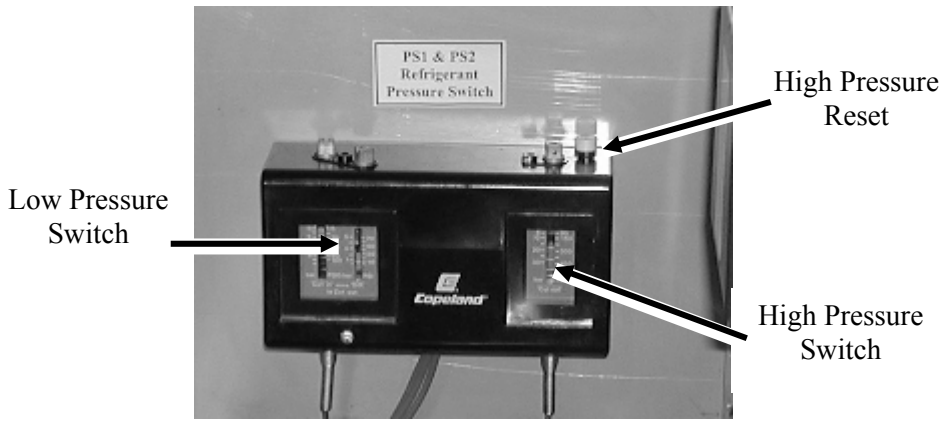
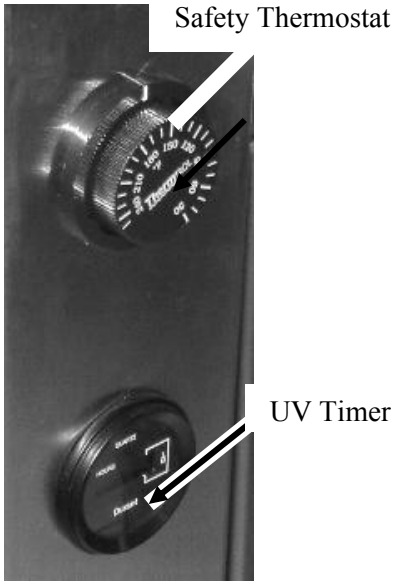


Figure A-2 - Pressure Switches



Over Temperature Thermostat An air over-temperature safety thermostat has been incorporated into the chamber. The temperature adjustment for this device is located at the rear of the unit, on the side of the heater housing. This safety thermostat is designed to protect the contents of the test chamber from excessive temperature rise in the event of a system failure. The operator may set this manually to protect the product under test, normally 2-3°C (5°F) degrees above highest test temperature. If this thermostat opens due to excessive temperature, the chamber will shut down and the SmartPad™ user interface will indicate "TEMPERATURE FAULT SET". The thermostat will automatically reset when the temperature inside the chamber drops below the cut-out temperature. After the thermostat has reset, the SmartPad™ user interface will indicate "TEMPERATURE FAULT CLEAR", and the system may be restarted by pressing the Standby key on the SmartPad™ key pad.

Figure A-3 – Low Water Safety Float Switch

Low-Water Safety Switch A low-water level safety float switch is located in the front left corner of the sump, near the floor of the sump; this switch will shut down the air handler if the water level in the sump falls below a safe operating level. If this float switch opens, the air handler will shut down. The SmartPad™ user interface will indicate "LOW WATER FAULT SET". The float switch will automatically reset when the water level in the sump returns to a safe operating level. After the switch has reset, the SmartPad™ user interface will indicate "LOW WATER FAULT CLEAR", and the system may be restarted by pressing the Standby key on the SmartPad™ key pad.

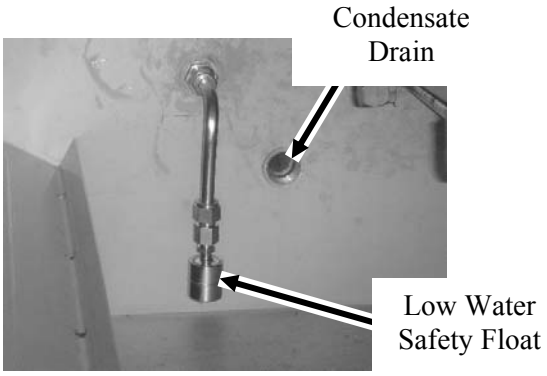


Figure A-4 – Low Water Safety Float Switch

Blower Motor Thermal Contact The blower motor is equipped with a contact that will open if the blower motor temperature exceeds a safe operating level. If this contact

opens, the air handler will shut down. The SmartPad™ user interface will indicate “FAN TEMP FAULT SET”. The thermostat will automatically reset when the blower motor tempeature returns to a safe operating level. After the thermostat has reset, the SmartPad™ user interface will indicate “FAN TEMP FAULT CLEAR”, and the system may be restarted by pressing the Standby key on the SmartPad™ key pad.

Motor Starter Protector If a motor starter protector (MSP) trips, that component will not operate. The starter must be reset by turning it to the Off position and then to the On position. MSPs are used by the process blower, pump, and compressor.

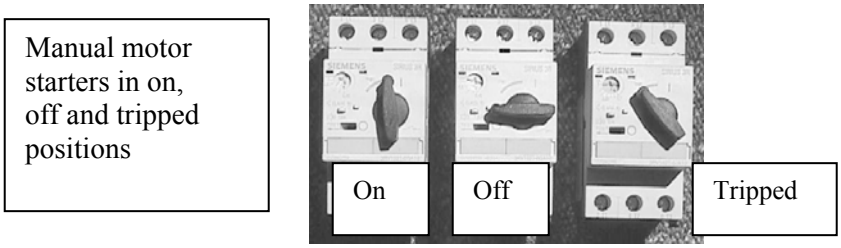


Figure A-5 – Motor Starter Protector (MSP)

TROUBLESHOOTING

CAUTION If the unit has a sight glass / moisture indicator, the hot gas bypass valve may cause a false indication of low refrigerant charge if the valve is not closed at the time it is being observed.

OPERATING RANGE OF THE SYSTEM.

When the system will not control properly there are many potential causes. A basic understanding of the operation of the system will assist in determining the cause of the problem.

1.) The air temperature will always be greater than the water temperature. Heat is removed from the air only when the air passes through the water spray.
2.) The water temperature can approach freezing, but it must not be allowed to freeze; the minimum water temperature is approximately 2.5°C (34.5°F). Since the dew point is determined by the temperature of the water spray, the minimum dew point will always be greater than the water temperature, thereby limiting the minimum achievable dew point.
3.) All blowers, pumps and compressors operate at all times. If any of these items are not operating, check for motor overload or failure or loose connections.
4.) Ambient conditions will limit operation of the unit. If the room temperature surrounding the conditioner is too warm or humid, heat cannot be properly rejected by the air cooled-condenser, affecting the chamber temperature and humidity.

NOTE The system will not operate if the low-water level safety switch has opened due to low water level in the sump.

WATER TEMPERATURE

1.) The refrigeration system controls the water temperature.
2.) If the water temperature is too high:
    a. Check for proper condenser operation.
        i. Is the condenser fan(s) operating?
        ii. Is the condenser coil clean? During normal operation lint, dirt and debris will deposit on the entering side of the condenser coil. This will reduce the cooling capacity of the condenser which will reduce the refrigeration capacity.
        iii. Is the air flow path for the condenser clear? Obstructions such as boxes, panels are walls can reduce the air flow across the condenser to the point that it will reduce refrigeration capacity.
        iv. Are all of the spray nozzles working? (All of the nozzles should have a similar spray pattern. If the patterns vary, remove the nozzles and clean the debris from the orifice)
        v. Is the (optional) finned evaporator clean and free of debris?
    b. Verify the operation of the refrigeration system
        i. When the hot gas valve is fully closed (i.e., water set point is much less than measured water temperature), the refrigeration sight glass should be clear. Any bubbles in the sight glass will indicate a low refrigerant charge.

ii. Is ice present on the fins of the evaporator (or on the surface of the submerged tube evaporator)? It is not unusual for the supply lines to the finned evaporator to be covered in ice; however, it is important that no ice form on the surface of the coil. Ice on the surface of the coil could indicate poor water flow or a low refrigerant charge.
iii. Is the refrigeration discharge pressure too high?
1. The air-cooled condenser could be dirty
2. The ambient temperature could be above 95°F
3. The condenser fan(s) may not be working

c. Does the heat load in the chamber exceed the capacity of the system? Since the heat from the air stream is removed by the evaporator and the water spray, if the heat load in the chamber is too great, the refrigeration system will become overloaded if the heat load in the chamber is too great. The first indication of this will be water temperature, and therefore Rh, that is higher than requested.

AIR TEMPERATURE

1.) The refrigeration system must have enough capacity to control the water temperature. If the water temperature is out of control, it is usually not possible to control the air temperature.
2.) Is the air damper operating properly? Press the clutch release on each actuator two times to initialize the motor. Observe that the damper moves full travel in both directions; this may take up to three minutes to complete. If the motor cannot reach the stops (the Phillips screws at each end of rotation), determine cause of the fault.
3.) Are the air heaters operating properly? Measure the air heater current when the SmartPad™ indicates 100% air heat output.
4.) Is the airflow restricted or the ductwork leaking? Ordinary A/C ductwork is not sufficiently vapor tight for an environmental chamber. The duct work must be capable of holding water for proper vapor barrier.
5.) Is the blower operating efficiently? Inspect the blower wheel for sediment that can accumulate over time, which decreases the efficiency of the wheel. If this build-up cannot be removed safely, the wheel must be replaced.
6.) Is the chamber properly sealed?
a. Check the seals around any doors and windows.
b. Are all covers properly installed?
7.) Has the load in the chamber increased?
8.) Check the line voltage. Low line voltage will drastically reduce the wattage of the air heaters and efficiency of the compressor.

WATER LEVEL

1.) The overflow drain must be connected to an open drain; the drain will not work properly if any backpressure is present.
2.) The overflow drain must functional. If the water level is above the overflow drain standpipe, the drain is not working properly and the refrigeration system may become overloaded.
3.) The float valve must maintain the proper water level. The proper water level is high enough to prevent the pump from cavitating (drawing air into the pump inlet), but should not be high enough to cause excessive, constant overflow (too much overflow will overload the refrigeration system)

RH CONTROL

1.) The humidity cannot be controlled if the water temperature or air temperature is out of control; refer to the respective troubleshooting section.

2.) Verify that the air flow through the mist eliminator is unrestricted; restrictions could permit water droplets to bypass the mist eliminator. If droplets contact the heater, the droplets will flash into steam and adversely affect the humidity control.

3.) Common Sense. Refer to the air/water/Rh graph supplied. Verify that the measured air and water temperatures will yield the Rh that is measured. Any gross errors may help to indicate the source of the problem.

   a. Verify the chamber air temperature and/or relative humidity using an independent sensor. This can be a rough verification just to make sure the air temperature and Rh measurements are close.
   b. Verify the water spray temperature using an independent sensor placed in the water sump. This can be a rough verification just to make sure the water temperature measurement is close.
   c. If the water spray temperature is considerably colder than should be required:
      i. If the ambient dew point is greater than the dew point in the conditioned space; check for excessive chamber or duct work leakage.
   d. If the water spray temperature is considerably warmer than should be required:
      i. If the ambient dew point is less than the dew point in the conditioned space; check for excessive chamber or duct work leakage.

MAINTENANCE

PGC chambers are designed to be reliable and require minimal maintenance. If the Conditioner is to be out of service for an extended period, it is advisable to clean the spray chamber interior to remove contaminants that collected; refer to "Spray Chamber" in the Preventive Maintenance Schedule table.

PREVENTIVE MAINTENANCE SCHEDULE

Component	What to Check	Periodicity
Blower Wheel	The blower wheel should be checked periodically for cleanliness. A dirty blower wheel may reduce airflow drastically. If the wheel cannot be cleaned, the blower should be replaced.	Annually
Condenser, Air-Cooled	Inspect and clean the outside coils. *Typical A/C condensers require less frequent cleaning than PGC air cooled condensers because they only operate part of the time.*	Quarterly
Heaters	Check resistance to ground; less than 50KΩ indicates a possible heater failure.	Annually
Spray Chamber	Drain and flush out the interior (including evaporator coil, spray eliminator, walls and sump) to remove deposits.	Quarterly or as needed
Spray Nozzles	The spray nozzles should be checked periodically to make sure they are free of foreign particles that might impair their operation. The spray pattern may be observed by opening the front access door. All spray jets should be working and spraying uniformly.	Quarterly or as needed
UV Lamp and Quartz Jacket	The UV filter lamp and quartz jacket should be replaced every 9,000 hours of operation.	Annually
Particulate Filter	Inspect and/or replace particulate filter as needed. Different applications will generate varying quantities of airborne particulates. Different water sources will also supply varying amounts of particulates. Due to this the service frequency for the particulate filter can vary widely. Visually inspect the filter frequently at first until an appropriate schedule can be developed.	Monthly (at first) then as needed.
Water RTD Calibration	RTD was calibrated at the factory. Re-calibration should not be necessary.	As needed
Air Temperature/Rh Calibration	HygroClip™ must be re-calibrated.	Annually, or as needed

Spray nozzles

It is important to change the water periodically. All water contains some impurities, and the spray water picks up anything in the air. During normal conditioner operation, some water vapor is lost

and the water is replaced by the supply. Over time, the concentration of all these impurities increases and deposit out on the coils and other parts of the chamber. Periodic draining and flushing with clear water will significantly reduce such accumulations.

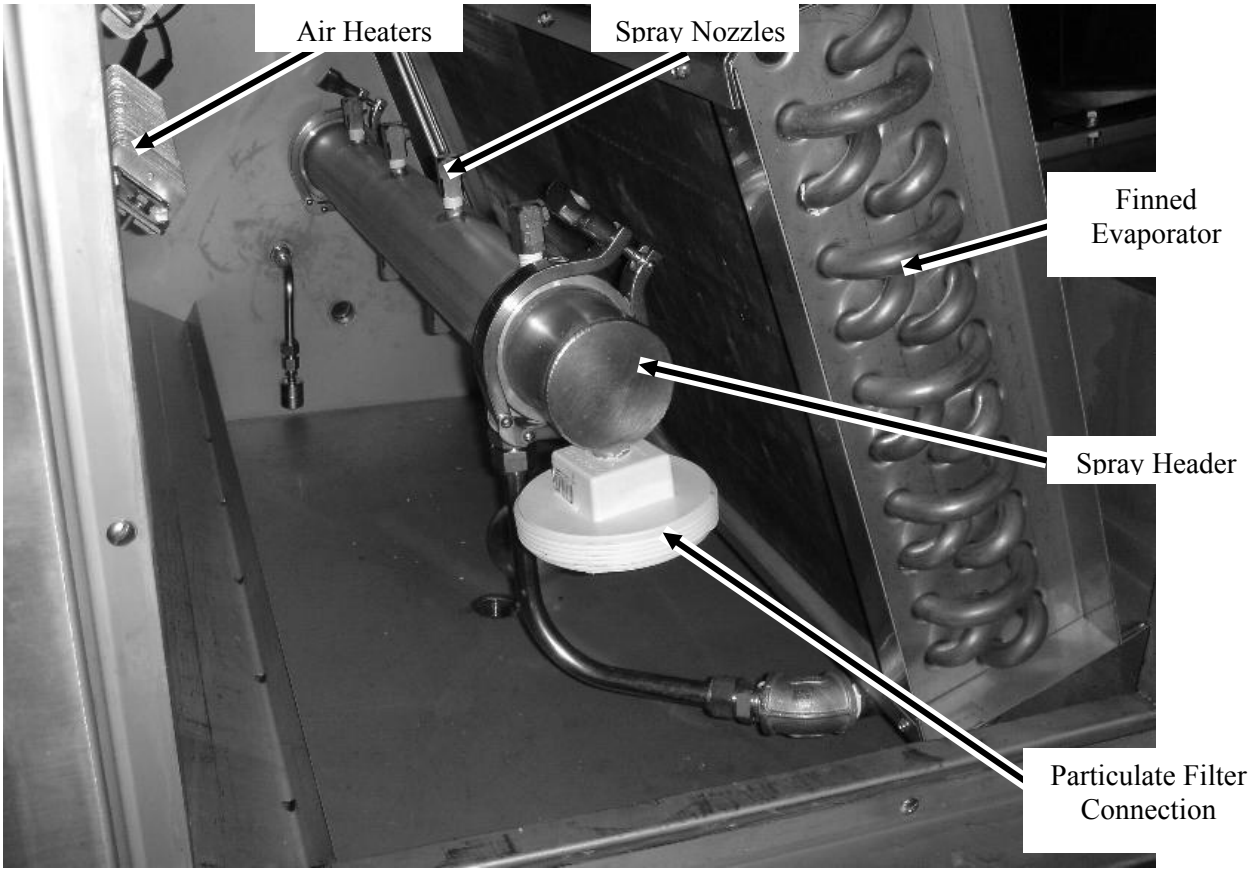


Figure A-2 – Spray Chamber

The spray nozzles should be checked periodically to ensure they are free of foreign particles that might impair their operation. The spray pattern may be observed by opening the access door. All spray jets should be working and spraying uniformly.

Particulate Filter

Proper filtration by the UV lamp requires that the water be free of particulates that block the UV light from passing through the water. The particulate bag filter is located in the sump and will trap particulates that are 5 microns and larger. This filter bag must be replaced periodically; the frequency of replacing this bag filter depends mostly upon the process in the test chamber and upon the environment in which the air handler is used. When starting a new process, inspect the filter frequently in order to determine the replacement frequency.

Figure A-7 – Particulate Filter

Replacement Instructions.

1. Turn the air handler off.

2. Remove the filter carrier by un-screwing it from the base..
3. Remove the used filter using an "un-screwing" motion.
4. Install the new filter. Typically, the filter can simply be "pressed" into the housing.
5. Replace the filter carrier.

UV Filter

CAUTION Oily fingerprints on the lamp or quartz tube will cause the lamp or quartz tube to fail prematurely. Wear gloves or wipe down these parts with alcohol before installing them in the system.

The UV filter lamp and quartz jacket should be replaced every 9,000 hours of operation (annually); an hour meter on the power panel keeps a cumulative time of operation. The UV lamp may continue to operate after 9000 hours of use, but the wavelength of the light produced will no longer provide an adequate kill rate. The lamp is accessed from the left access door of the unit. To replace the lamp, shut down the unit by pressing the SmartPad™ Standby key , disconnect power from the unit, pull out the lamp using the harness cap as a handle until the lamp is extended far enough to unplug the harness, and withdraw the lamp from the unit.

UV Filter Removal Instructions.

1. Turn the air handler off. The quartz tube will be under discharge pressure from the water spray pump.
2. Gently pull the UV lamp harness to remove the UV lamp from the quartz tube
3. Disconnect the lamp from the harness.
4. Remove the lamp from the quartz tube.
5. Remove the solid cap from the other end of the spray header. This will provide access to the quartz tube support bracket, located inside of the spray header.
6. Remove the quartz tube support bracket.
7. Remove the blue, aluminum gland nut and S/S retaining washer from the UV mounting flange.

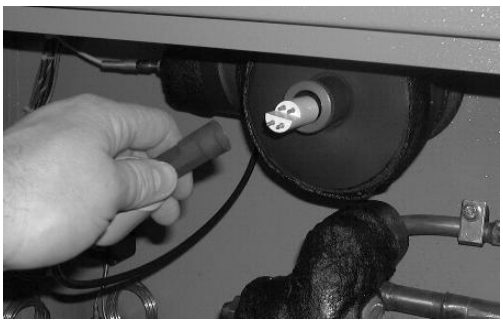


Figure A-3 – Disconnect the wiring harness

Figure A-4 – Remove the lamp

8. Remove, and loosely install the new quartz tube. Clean the new tube and lamp surface with alcohol to remove fingerprints, or use un-powered latex gloves to prevent oil on the glass surface of usable components.
9. Carefully install the quartz tube support bracket inside the spray tree.
10. Re-install the solid spray header cap.

11. Install the quartz tube o-ring, S/S retaining washer and the blue, aluminum gland nut. Do not over tighten the gland nut or the quartz tube will crack.
12. Install the new UV lamp and connect the wiring harness. The rubber boot on the wiring harness will secure the lamp in the quartz tube.

Figure A-6 – Remove the gland nut

Figure A-5 – Spray header with solid cap removed. (quartz tube support bracket exposed)

AUTOMATIC DAMPER MOTOR ADJUSTMENTS

The damper actuator is designed to rotate a full 90°C, which may be more than necessary for the air bypass damper on this unit. To accommodate for the limited movement of the damper, the mechanical stops (Philips screws) on the actuator shaft are adjusted to reduce the operation range of the motor.

After the stops are adjusted the actuator must be acclimated. This is an initialization procedure that informs the actuator where the physical stops are located. To perform the acclimation process remove the control input signal from PLC1 to the damper actuator. Then, while the input signal is disconnected, press the clutch on the actuator two times. The motor will then cycle to both stops. After the cycle is complete, re-connect the input signal.

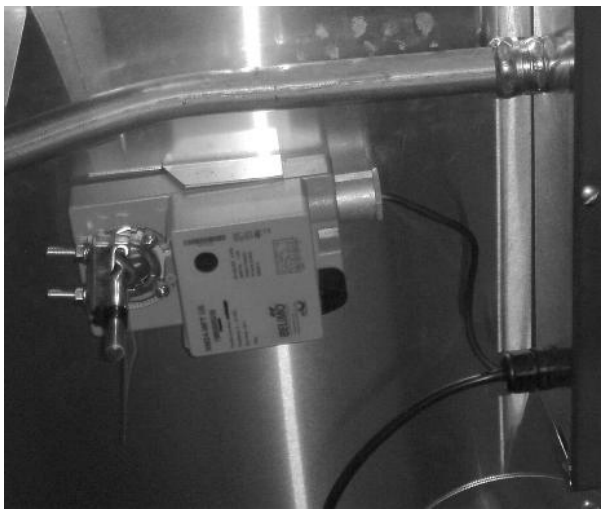


Figure A-12 – Air Bypass Damper Actuator

CALIBRATION

CALIBRATION, AIR/RH

The air temperature and Rh are measured by a self-contained and calibrated Rotronics HygroClip™ T/Rh transmitter. The Rotronics HygroClip™ T/Rh transmitter should be recalibrated annually. The three different options for calibration are Exchange, Calibration in an Independent Chamber, and Calibration In Place

Exchange
Both PGC and Rotronics© (the sensor manufacturer) have a sensor exchange program. Contact Rotronics© for details regarding their plan and calibration schedule. For a nominal calibration fee, PGC will provide a calibrated temperature and Rh transmitter as often as you desire. The replacement sensor will be shipped complete with calibration data that can be used for validation. The returned sensor will be re-calibrated and used as an exchange sensor in the future. The "as found" data from the returned sensor can be forwarded to the customer to be used for validation. Contact PGC for current pricing for this service.

The customer can also purchase a second calibrated transmitter, which can be interchanged with the original sensor. The original sensor can then be returned to Rotronics©, PGC, or a calibration laboratory for re-certification. This process can then be repeated on a schedule determined by the customer's specific requirements.

Calibration in an independent chamber
The HygroClip can also be calibrated through the serial port of a Windows based PC. An interface cable, available from Rotronics, allows the PC to communicate directly to the HygroClip. The HygroClip is then positioned in a stable chamber, compared to a reference standard, and adjustments made to the calibration constants from the PC. Contact Rotronics or PGC for more details regarding PC based HygroClip calibration.

Calibration in place
Rotronics© produces a hand-held device, called a HygroPalm™, that can be used to calibrate the HygroClip™ transmitter, without removing the transmitter from the air handler. A special cable, available from PGC, is connected from the HygroPalm to the communication line in the conditioning unit. The HygroPalm then interrupts the communications from the HygroClip™ to the PLC in order to modify the calibration constants that are stored in the HygroClip™. The HygroPalm can be equipped with a second, calibrated HygroClip™ that is used as a reference probe, or an independent reference, supplied by the customer or the calibration technician, can be used as the reference.

The actual location of the connection for the HygroPalm™ depends on where the HygroClip™ is located.

If the HygroClip™ is located within 5 meters of the PLC in the electrical compartment on the air handler, it does not require external amplification of the digital signal. In this case, the HygroClip™ can be connected directly to the PLC. To calibrate a HygroClip™ connected directly to the PLC, the HygroPalm™ interface cable should be connected to the DIO and common connections on the PLC pc board. This connection can be "piggy-backed" onto the existing wires in these terminals, or a special cable, available from PGC can be used to connect to a calibration header on the circuit board.

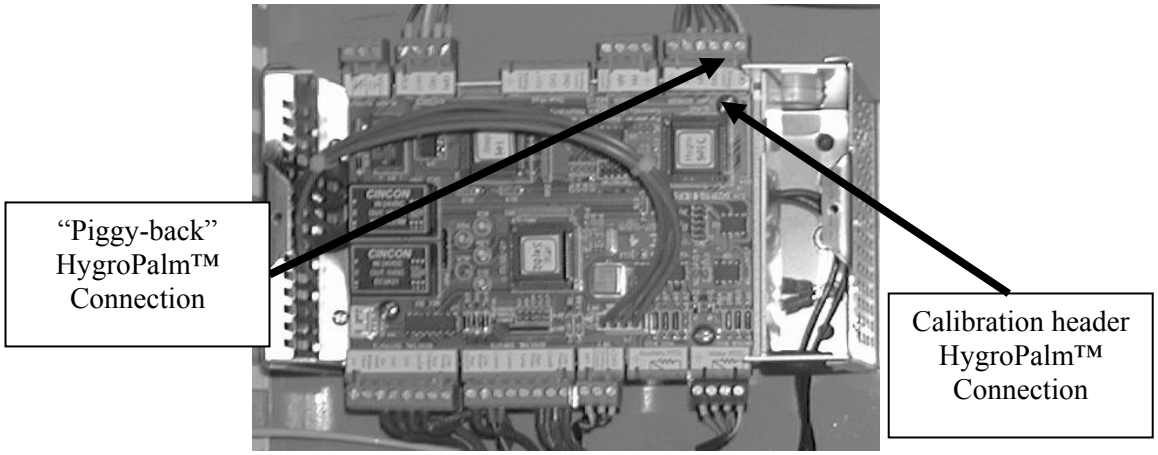


Figure A-13 – ACE4 PCB,
HygroPalm™ Connection

If the HygroClip™ is located more than 5 meters from the air handler, it will require an amplifier on the digital signal. The HygroPalm™ cannot calibrate "through" the amplifier. This means that the HygroPalm™ must be connected to the DIO and common on the sensor-side of the amplifier. The DIO amplifier is located in a plastic box near the HygroClip™. Two terminals are provided for the DIO and common connections from the HygroPalm™.

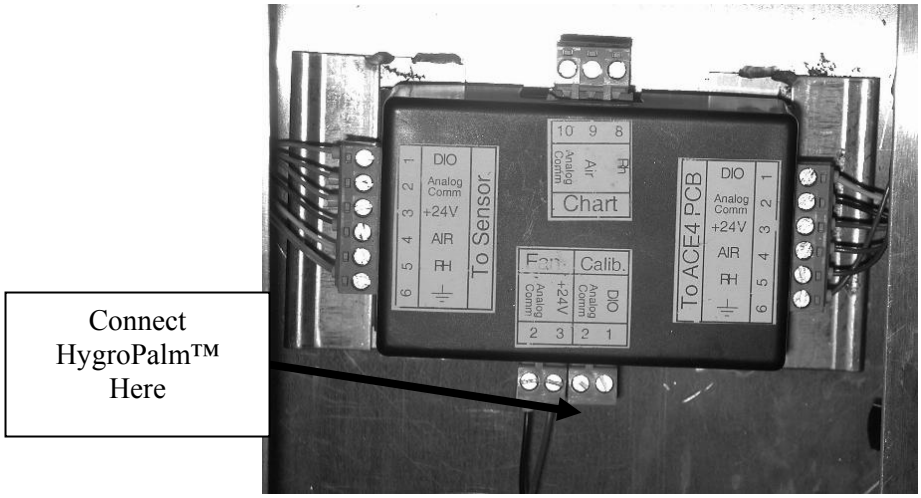


Figure A-15 – DIO Amplifier,
HygroPalm™ Connection

HygroPalm© Single-Point Temperature Calibration Procedure

1.) Install a temperature reference as close as possible to the HygroClip© sensor.
2.) Using a special cable from PGC (Part Number 1609-866), connect the HygroPalm© to ACE pc board at the two-pin connector in the upper left-hand corner, labeled DIO. It is important to note that as long as the HygroPalm© is connected to the ACE pc board, the chamber controller cannot communicate with the HygroClip©; therefore, it is important make the calibration adjustment as quickly as possible.
3.) Press the HygroPalm© down arrow key until the display indicates "PROBE 2". The display should indicate the temperature and Rh measured by the HygroClip© in the air handler/chamber. If the display does not indicate the measured temperature and Rh, check the cable connection
4.) Press the MENU key. The display will indicate "CALCULATE"
5.) Press the down arrow ↓key until the display indicates "ADJUST 1 PT."
6.) Press ENTER. The display will indicate "RHS".
7.) Press the down arrow key until the display indicates "Temperature".
8.) Press ENTER. The display will indicate the current measured temperature. Press the UP or DOWN ARROW keys until the measured temperature matches the temperature measured by the reference standard.
9.) Press ENTER. The display will respond "sure?". Press ENTER again to enter the calibration offset.
10.) The display will respond "wait" until the data written to the HygroClip©.
11.) When "wait" disappears, you can press ENTER to return to the measured value display screen.

HygroPalm Single-Point Rh Calibration Procedure

1.) Install an Rh reference as close as possible to the HygroClip© sensor.
2.) Using a special cable from PGC, connect the HygroPalm© to the ACE pc board at the two-pin connector in the upper left-hand corner. It is important to note that as long as the HygroPalm© is connected to the ACE pc board, the chamber controller cannot communicate with the HygroClip©; therefore, it is important make the calibration adjustment as quickly as possible.
3.) Press the HygroPalm© down arrow key until the display indicates "PROBE 2". The display should indicate the temperature and Rh measured by the HygroClip©. If the display does not indicate the measured temperature and Rh, check the cable connection
4.) Press the MENU key. The display will indicate "CALCULATE"
5.) Press the down arrow key until the display indicates "ADJUST 1 PT."
6.) Press ENTER. The display will indicate "RHS".
7.) Press the down arrow key until the display indicates "Humidity".
8.) Press ENTER. The display will indicate the current measured relative humidity.
9.) Press the UP or DOWN ARROW keys until the measured Rh matches the Rh measured by the reference standard.
10.) Press ENTER. The display will respond "sure?". Press ENTER again to enter the calibration offset.
11.) The display will respond "wait" until the data written to the HygroClip©. When "wait" disappears, press ENTER to return to the measured value display screen.

WATER TEMPERATURE CALIBRATION

The water RTD (RTD1) can be calibrated via the user interface. This sensor was calibrated prior to shipment and typically will not require re-calibration. However, if calibration is necessary refer to the SmartPad™ user interface manual for details regarding the water RTD calibration screens.

The water RTD can be calibrated by plugging precision resistors in place of the RTD, or by comparing the temperature measured by the water RTD with a reference standard. In either method, the RTD can be calibrated using a zero and span adjustment, or it can be calibrated to a single offset point. If the single offset point adjustment is required, use the Zero routine.

Water RTD Calibration Procedure with Reference Standard:

1.) Zero Offset, or Single Point Offset.

a. Place the reference standard (NIST traceable thermometer or thermocouple) in the center of the sump, half-way down in the water.
b. Operate the system at the minimum water temperature; or if performing a single point offset calibration, operate the system at the desired offset temperature.
c. Access the RTD calibration screens in the SmartPad™:
   - On the Process Variables screen, press MORE (F4), then PREF (F2), and enter the access code (factory setting: 0000) to access the Area modification screen.
   - Press CAL (F3) to access the Water Calibration screen.
d. Enter the temperature measured by the reference standard and press ZERO (F1).
e. Press “CAL” (F1); after a few seconds, observe the Actual Value matches the Reference Value.
f. Press “DONE”.

2.) Span (Gain) Adjustment:

a. Operate the system at or near the maximum water temperature and allow several hours for the temperature to stabilize.
b. Access the RTD calibration screens in the SmartPad™:
   - On the Process Variables screen, press MORE (F4), then PREF (F2), and enter the access code(factory setting: 0000) to access the Area modification screen.
   - Press CAL (F3) to access the Water Calibration screen.
c. Enter the temperature measured by the reference standard and press SPAN (F2).
d. Press “CAL” (F1); after a few seconds, observe the Actual Value matches the Reference Value.
e. Press “DONE”.

Water RTD Calibration Procedure with Precision Resistors:

1.) Zero Offset, or Single Point Offset.

a. Place the low temperature precision resistor in the RTD circuit.
b. Access the RTD calibration screens in the SmartPad™:
   - On the Process Variables screen, press MORE (F4), then PREF (F2), and enter the access code(factory setting: 0000) to access the Area modification screen.
   - Press CAL (F3) to access the Water Calibration screen.
b. Enter the temperature measured by the reference standard and press ZERO (F1).
c. Press "CAL" (F1); after a few seconds, observe the Actual Value matches the Reference Value.
c. Press "DONE".

2.) Span (Gain) Adjustment:

a. Place the high temperature precision resistor in the RTD circuit.
b. Access the RTD calibration screens in the SmartPad™:
   - On the Process Variables screen, press MORE (F4), then PREF (F2), and enter the access code(factory setting: 0000) to access the Area modification screen.
   - Press CAL (F3) to access the Water Calibration screen.
c. Enter the temperature represented by the precision resistor and press SPAN (F2)
d. Press "CAL" (F1); after a few seconds, observe the Actual Value matches the Reference Value.
e. Press "DONE".

Notes:

www.humiditycontrol.com (800) 438-5494
sales@humiditycontrol.com Fax (828) 669-6928 (828) 669-8717
Black Mountain, North Carolina

Parameter Generation and Control, Inc.
Black Mountain, North Carolina

(828) 669-8717

SmartPad™ Operation Manual
Steady State and Programmable Set Point Entry Mode

Software Version 0.503
November, 2005

PGC SmartPad™ CONTROL SYSTEM version 0.503

The SmartPad™ control system consists of a user interface and a unit control module. The user interface is the SmartPad™ and the control module is located in the electrical compartment of the machine. The SmartPad™ will be accessible to the user. An RS-232 cable will connect the two devices. **This manual will discuss the operation of the SmartPad™ only. The operation of the remainder of the control system is discussed in the unit manual.**

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SmartPad™ USER INTERFACE

The SmartPad™ was initially shipped with an access code of 0000. If the code has been changed and lost, please contact PGC for assistance.

The SmartPad™ may be configured in a steady state or 60 segment programmable controller set point entry mode as desired.

The SmartPad™ software is capable of operating in several control modes, two temperature, cascade, dryer and slow damper mode. This software will also behave differently based on the temperature range (low temperature or standard range) Some modes are not applicable for every system.

In two-temperature mode the air and water set points are entered directly by the user. The desired Rh must be determined either by measuring the conditions in the chamber, or by using a standard air/Rh/water spray graph.

In the cascade and slow damper modes the user enters the air temperature and Rh set points. The water set point is automatically determined by the control unit module. Slow damper mode is similar to cascade mode except that it will provide slow damper outputs for the air control loop.

Dryer mode is applicable only for units equipped with a desiccant dryer. In this mode, the air temperature and Rh are entered by the user. The Rh is controlled using a desiccant dryer. The dryer controller can be configured for bypass or reactivation heater capacity control. The type of dryer control is pre-configured at the factory. The displayed screens will be different based on the type of control selected.

SmartPad™ software is capable of operating with both analog and digital temperature and Rh sensors. Certain features will be disabled or enabled, depending on which type of sensor is applied. For example, if digital sensors are applied, the water RTD calibration is accessible from the SmartPad™. With analog sensors, this feature is disabled.

The on/off function of the system is also configured to match the hardware applied. If the system is equipped with an on/off switch, the on/off function in the SmartPad™ is disabled. When the on/off function in the SmartPad™ is enabled, a standby key will be present in the lower, right corner of the keypad. When the SmartPad™ is powered up for the first time, in this configuration, a screen will appear that indicates how to energize the rest of the system. Pressing the on/off key will enable or disable the system, each time it is pressed.

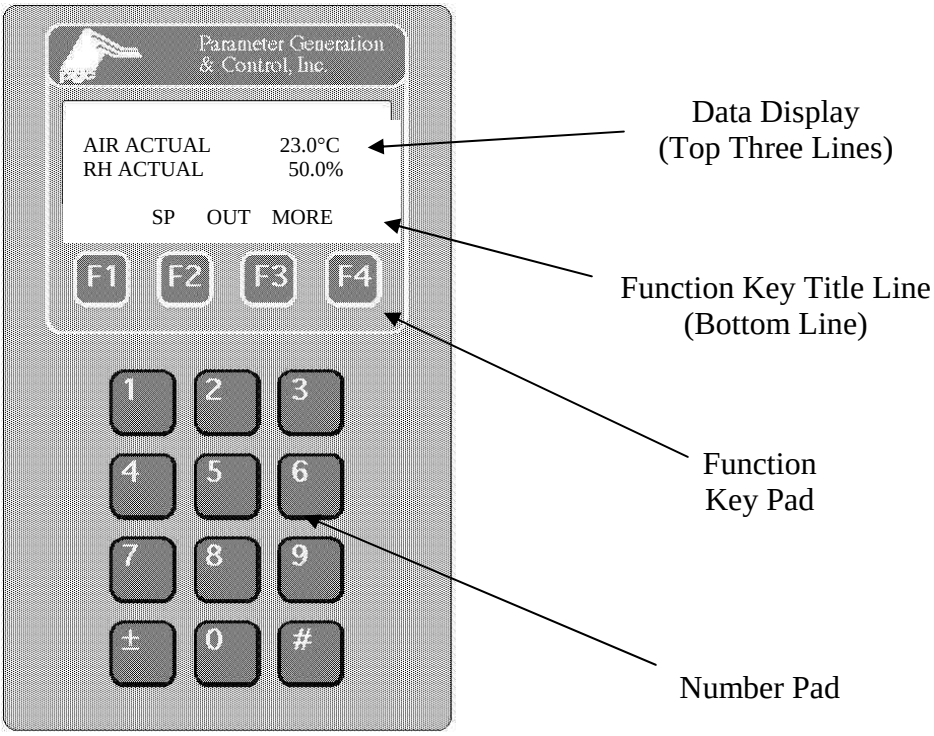
The SmartPad™ is capable of communication with a remote terminal via RS-232 protocol. A DB-9 connector is provided for ease in connection. Refer to the serial communications section of this manual for more information.

The SmartPad™ control interface is designed to be as user friendly as possible. The basic purpose of the control system is to provide a display with various screens used for entering the desired operating conditions for the conditioner, as well as to display the actual conditions measured by the sensors.

The four function keys perform different tasks depending on the current screen displayed. The bottom line of the display is used as a programmable label for the function key that is directly below it. If a key has no function or if the function is disabled, the title is blanked out.

Screen progression charts are provided to help illustrate the screens available in each mode. There is a chart for each of the four modes, two temperature, cascade, dryer and slow damper cascade. Many of the screens are available in different modes and have exactly the same function. Each individual screen discussion will indicate the different options available in the modes.

Note: There is not an "ENTER" key. A field must be completely filled by entering numerals from the number pad.



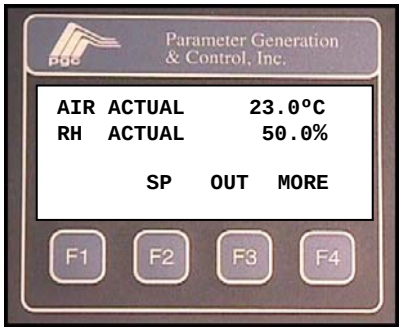
SmartPad™ Control Interface

Process Variable Screen (Steady State Mode)

The process variable screen displays the measured air temperature and relative humidity or water temperature (depending on the operating mode chosen).

Depressing the **ESC** function key on **any** screen will access the process variable screen.

AIR or RH/H2O ACTUAL indicates the current measured conditions in the chamber.



Key for function keys action

F1 = no function
F2 = SP: access set point screen
F3 = OUT: access output screen
F4 = MORE: access screen

Process Variable Screen (Programmable Mode)

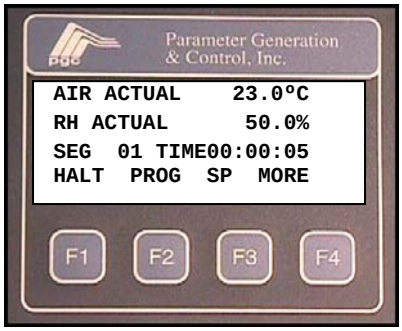
The process variable screen displays the measured air temperature and relative humidity or water temperature (depending on the operating mode chosen) as well as the current segment and the time left in that segment.

Depressing the **ESC** function key on **any** screen will access the process variable screen.

AIR or RH/H2O ACTUAL indicates the current measured conditions in the chamber.

SEG indicates the current segment.

TIME indicates the time left in the current segment. If the program is running the time will be decrementing. If the program is halted the time will be static.



Key for function keys action

F1 = Toggles from RUN to HALT to start or stop the program.
F2 = PROG: access program entry screen
F3 = SP: access the set point monitor screen
F4 = MORE: access preferences screen

Output Screen (Steady State and Programmable Modes)

The output screen indicates the position of the air bypass damper, dryer bypass damper and the power applied to the air and water heaters. These outputs can be in the range of 0.00% (full cooling) to 100.0% (full heating). **This screen is view only.**

AIR DAMP OUT indicates the position of the bypass damper. This output is present only in slow damper cascade mode.

AIR HEAT OUT indicates the duty cycle of the resistance heaters in the air stream. This will also relate to the position of the air bypass damper actuator in the two temperature and cascade control modes. This output is presenting all modes.

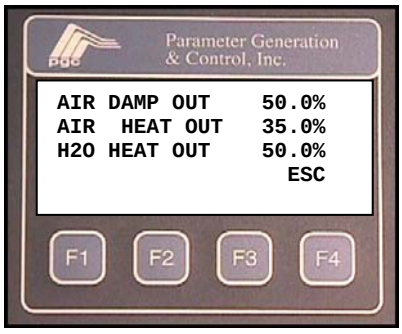
* When the system operates in low temperature mode the output percentage of the air heaters is limited in firmware. A typical firmware limit would be 10%. This means that if the air heat control is calling for output in low temperature mode, the actual heater will only be energized 10% of the time. If the air heat control is calling for 1/2 output in low temperature mode, the actual heater will only be energized 5% of the time.

* When the system is operating in normal (not low temperature mode) the air heat out will reflect the actual heater duty cycle.

H2O HEAT OUT indicates the duty cycle of the resistance heaters in the water control system. This will also relate to the position of the hot gas bypass control actuator in the refrigeration system. This output is present in all modes except for dryer mode and low temperature mode.

REFRIG. OUTPUT indicates the position of the hot gas bypass control actuator in the refrigeration system. This output is present only in low temperature mode. When the system is operating in low temperature mode, the refrigeration capacity is a function of the air temperature control loop, rather than the water temperature control loop.

DRYER OUTPUT indicates the position of the desiccant dryer control dampers. This output is present only in dryer mode.



Key for function keys action

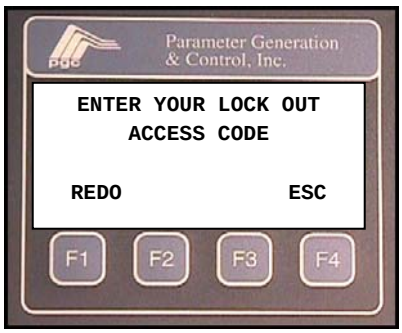
F1 = no function
F2 = no function
F3 = no function
F4 = ESC: return to process variable screen

Preferences Screen (Steady State and Prog Modes)

The access screen allows the user to enter a four-digit password to gain access to the customer configuration and factory configuration screens.
The user can configure the password to any four digits they choose except for **7178**.

7178 is factory written to allow access to the factory configuration screen. The factory configuration screens allow access to set point entry mode (SS or Programmable) and operating mode (2temp, cascade, dryer or slow damper).

The user's custom code (0000 when the unit is shipped) will allow access to the customer configuration screens. These screens will allow the user to reprogram the access code, address the alarm parameters, lock the keypad, calibrate the digital water RTD and modify the tuning parameters.



Key for function keys action

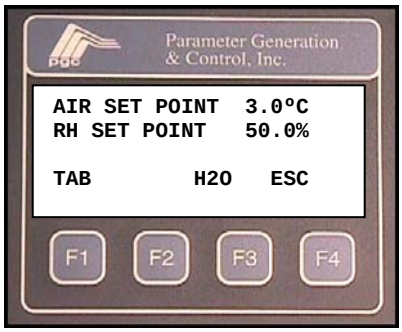
F1 = REDO: try again without filling the field
F2 = no function
F3 = no function
F4 = ESC: return to process variable screen

Process Set Point Screen (Steady State Mode)

The process set point screen displays the current air temperature and water temperature or Rh set point. This screen allows the user to view and/or modify the set points for the system.

Note 1: The controller does not have an ENTER key. The set point will be entered into the controller when the entire field is filled. When the field is filled the cursor will return to the beginning of the field to indicate proper data entry.

Note 2: This screen can be locked out. Locking this screen will enable any user to view the set point but will not allow changes to the set point. If this screen is locked out the cursor will not be visible and the TAB key will have no label or function.



Key for function keys action

F1 = TAB: positions the cursor
F2 = no function
F3 = H2O: access the monitor water values screen (in dry mode this key will access the react heater screen "RCT")
F4 = ESC: return to process variable screen

Program Set Point Screen (Programmable Mode)

The program set point screen allows the user to enter the program data. Up to 40 segments can be entered (00-39). Each segment must include a duration time as well as the two set point parameters (Air/Rh in cascade, dryer or slow damper mode or Air/Water in two temperature mode). The duration time will be the amount of time required for the set point to change from its current value to the value defined by that segment.

Typically, a program will consist of a sequence of ramps and dwells. A ramp would define the time required for the set points to change from one condition to another. A dwell would define the amount of time that the set points will remain stable at the new set point. In this fashion, it will usually require two segments (one ramp and one dwell) for each condition that is to be achieved.

The time duration must be in a range from 0 seconds to 17 hours, 59 minutes, 59 seconds. If longer segments are require simply program two segments to double the time.

Keep in mind that the SmartPad™ is only controlling the amount of time required for the set points to change. The actual time required for the conditions in the chamber to change will depend on several physical factors.

SEG: indicates the segment to be programmed.

TIME: indicates the duration of the segment being programmed.

AIR and WATER or RH SETPOINT: indicates the set point for that parameter that is to be obtained **after** the time has expired.

Key for function keys action

F1 = TAB: increments the cursor from field to field
F2 = NEXT: accesses the next segment
F3 = INIT: access the initialization screen
F4 = ESC: return to process variable screen

Initilization Screen (Programmable Modes)

The initialization screen allows the user to specify the loop parameters for the ramp and soak profile.

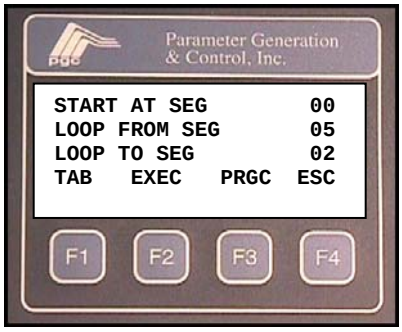
START AT SEG indicates the initial segment in the profile.

LOOP FROM SEG indicates the final segment in the profile.

LOOP TO SEG indicates the segment the controller will execute immediately following the final segment.

For example: If; START AT SEG = 00, LOOP FROM SEG = 05; LOOP TO SEG = 02.
The controller will execute segments 00 through 05 in sequence then loop from 05 to 02. The controller will then continue to execute segments 02 through 05 indefinatly until the profile is halted or altered.

Example #2: If; START AT SEG = 00, LOOP FROM SEG = 05; LOOP TO SEG = 05.
The controller will execute segments 00 through 05 in sequence. Then, since the loop to segment is the same as the loop from segment, the controller will loop from 05 to 05. The controller will then continue to execute segment 05 indefinatly until the profile is halted or altered.



Key for function keys action

F1 = TAB: increments the cursor from field to field
F2 = EXEC: instructs the controller to execute the profile defined by the loop parameters.
F3 = PRGC: access the mode configuration screen
F4 = ESC: return to process variable screen

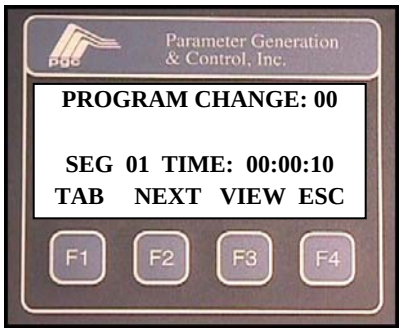
Mode Configuration Screen (Programmable Modes)

The mode configuration screen allows the user to enable certain features and automatically change operating modes.

PROGRAM CHANGE: indicates the data that can be programmed (two characters).

SEG: indicates the segment to be programmed.

TIME: indicates the duration of the segment being programmed. (Note: this field is read only)



Key for function keys action

F1 = TAB: increments the cursor from field to field
F2 = NEXT: accesses the next segment.
F3 = VIEW: access the current configuration viewing screen
F4 = ESC: return to process variable screen

The data is arranged in two characters that represent a single byte (or two nibbles). Each nibble can be represented by a hexadecimal number from 0 to 9 (hex A through F are not used).

The high nibble (left digit) consists for four digital switches. Each switch is closed or on when the bit is high, and off when the bit is low.

The low nibble (right digit) is used to configure the operating mode of the chamber. Bit 2 is used as a reconfigure indicator. If this bit is set, the system will reconfigure the operating mode. If this bit is clear, the system will ignore the mode indicator. Bits 0 and 1 represent the mode indicator.

Left Nibble Definition			
Data	**Output 1**	**Output 2**	**Output 3**
0x	**OFF**	**OFF**	**OFF**
1x	**ON**	**OFF**	**OFF**
2x	**OFF**	**ON**	**OFF**
3x	**ON**	**ON**	**OFF**
4x	**OFF**	**OFF**	**ON**
5x	**ON**	**OFF**	**ON**
6x	**OFF**	**ON**	**ON**
7x	**ON**	**ON**	**ON**
8x	**OFF**	**OFF**	**OFF**
9x	**ON**	**OFF**	**OFF**

Right Nibble Definition		
Data	**Reconfigure**	**Mode**
x0	**NO**	**NO ACTION**
x1	**NO**	**NO ACTION**
x2	**NO**	**NO ACTION**
x3	**NO**	**NO ACTION**
x4	**YES**	**CASCADE MODE**
x5	**YES**	**TWO TEMPERATURE MODE**
x6	**YES**	**DRY MODE**
x7	**YES**	**SLOW DAMPER MODE**
x8	**NO**	**NO ACTION**
x9	**NO**	**NO ACTION**

Programming examples:

PRGC = 00
All digital outputs are off.
System will not reconfigure.

PRGC = 10
Digital output #1 is on.
System will not reconfigure.

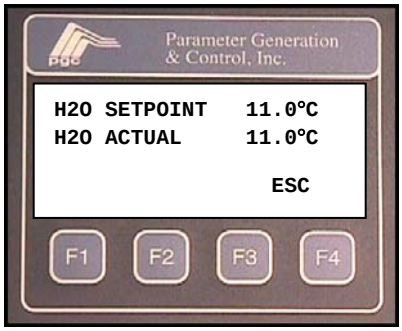
PRGC = 04
All digital outputs are off .
System will reconfigure to mode 00 (Cascade mode)

PRGC = 14
Digital output #1 is on.
System will reconfigure to mode 00 (Cascade mode)

PRGC = 16
Digital output #1 is on.
System will reconfigure to mode 02 (Dry mode)

Monitor Water Values Screen (Steady State and Prog Modes)

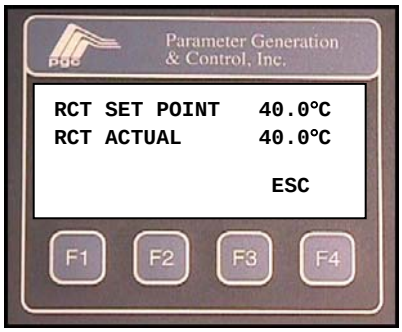
The monitor water values screen allows the user to observe the measured water temperature and the water set point that is determined by the cascade control loop. These values cannot be modified. This screen is for monitoring only. **This screen is available only in cascade or slow damper cascade mode.**



Key for function keys action
F1 = no function
F2 = no function
F3 = no function
F4 = ESC: return to process variable screen

Monitor React Values Screen (Steady State and Prog Modes)

The monitor react values screen allows the user to observe the measured reactivation temperature and the reactivation set point that is determined by the desiccant dryer control loop. These values cannot be modified. This screen is for monitoring only. **This screen is available only in dry mode, and only if the controller is configured for reactivation heater control.**



Key for function keys action
F1 = no function
F2 = no function
F3 = no function
F4 = ESC: return to process variable screen

More Screens (Steady State and Prog Modes)

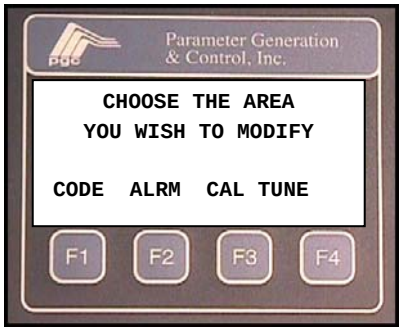
The more screen provides access to the alarm condition screen and the preference screen.

This screen will also display the serial number of the system, the SmartPad software version number and the current operating mode.

Key for function keys action
F1 = ALM: access the alarm information screen
F2 = PREF: access the access code screen
F3 = no function
F4 = ESC: return to process variable screen

Area Modification Screen (Steady State and Prog Modes)

The area modification screen is the first screen that is encountered when the user's custom access code is entered into the access screen. This screen allows the user to select the user accessible configuration options.



Key for function keys action

F1 = CODE: access the access code screens
F2 = ALRM: access the alarm screens
F3 = CAL: access the digital RTD Calibration screen(s)
F4 = TUNE: access the tuning screens

Alarm Condition Screen (Steady State and Prog Modes)

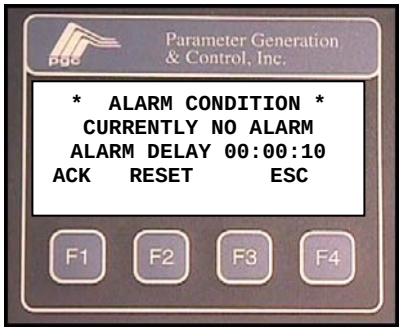
The alarm condition screen indicates the status of all alarms in the system.

Line two will indicate the current alarm or no alarm if the system is not in an alarm condition. If multiple alarms occur only the first alarm will be displayed.

Line three indicates the alarm delay. This is a user defined delay timer for the alarm. An alarm condition will not trigger an alarm until the alarm delay timer has expired. Line two will display the alarm as soon as it occurs and line three will begin to decrement the timer. If the alarm condition is corrected before the alarm delay timer expires no alarm will occur. If the alarm condition is not corrected and the alarm delay timer expires the display will flash on a one second interval and the alarm output will change state.

ACK will acknowledge the alarm condition. This will cause line two to display "*ALARM ACKNOWLEDGED*". This is not the same as resetting the alarm. Acknowledge will keep the display from flashing but will not reset the open collector output. The purpose of the acknowledge function is to allow better access to the screens without the flashing display. As long as the alarm is acknowledged no new alarms will be recognized.

RESET will reset the alarm system. The display will cease to flash. The open collector output will open. Any new alarm will trigger the alarm delay timer and will be recognized if the timer expires.



Key for function keys action

F1 = ACK: acknowledge an alarm but not reset the output
F2 = RESET: reset the alarm and alarm output
F3 = no function
F4 = ESC: return to process variable screen

Access Code Screen (Steady State and Prog Modes)

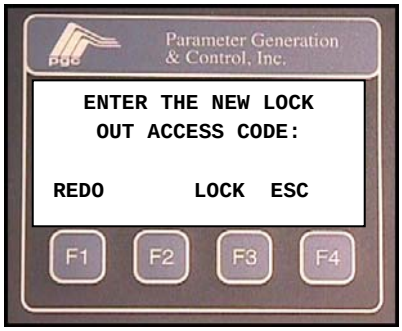
The access code screen is accessed from the area modification screen by choosing CODE. Entering a four-digit number will change the access code to the value entered.

Pressing DONE will access the current access code screen to display the access code.

Pressing REDO will discard any entered digits and allow a new code to be entered.

Note: All four digits must be entered in order to change the code.

LOCK (F3) will toggle between LOCK and UNLOCK. When the display reads UNLOCK, the set points cannot be modified. When the display reads LOCK, the set points are accessible.



Key for function keys action

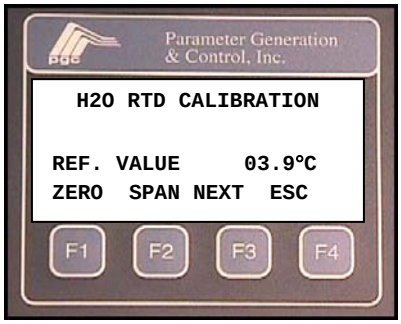
F1 = REDO: try again without filling the field
F2 = no function
F3 = LOCK: lock or unlock access to the Set points.
F4 = ESC: return to process variable screens

Water RTD Calibration Screen (Steady State and Prog Modes)

This screen is only accessible when the system is equipped with digital sensors. If analog sensors are installed, pressing CAL will return to the process variable screen.

When a digital air/Rh sensor is used, the water temperature is measured using an RTD that is connected directly to the controller. The controller then converts the RTD resistance to a digital temperature measurement using a 16-bit A/D converter. The offset (zero) and scaling (span) of this A/D converter input can be adjusted from the SmartPad keypad. Refer to the system user manual for step by step procedures to make this adjustment.

REF. VALUE Enter the temperature that should be displayed by the water temperature measurement circuit.



Key for function keys action

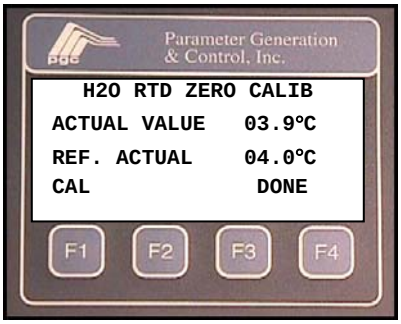
F1 = ZERO: access the zero adjust screen
F2 = SPAN: access the span adjust screen
F3 = NEXT: access other RTD calibrations
F4 = ESC: return to process variable screen

Water RTD ZERO Calibration Screen (Steady State and Prog Modes)

The first step in calibrating the water RTD is to set the zero or offset value. This value should be as close as practical to the minimum operating temperature.

ACTUAL VALUE: will indicate the current water temperature, as it is measured by the input circuit. This value will change to indicate the calibration offset, after the CAL key is pressed.

REF. VALUE will indicate the reference value entered in the water RTD calibration screen



Key for function keys action

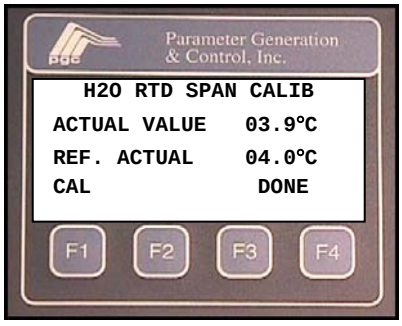
F1 = CAL: instructs the A/D converter to accept the new zero offset value.
F2 = no function
F3 = no function
F4 = DONE: allows the user to exit the screen after the offset value has been accepted. Returns to the water RTD calibration screen

Water RTD SPAN Calibration Screen (Steady State and Prog Modes)

After the water RTD zero adjustment it is necessary to adjust the span or scaling factor for the input. This adjustment will determine the slope of the calibration curve. This value should be as close as practical to the maximum operating temperature.

ACTUAL VALUE: will indicate the current water temperature, as it is measured by the input circuit. This value will change to indicate the calibration offset, after the CAL key is pressed.

REF. VALUE will indicate the reference value entered in the water RTD calibration screen



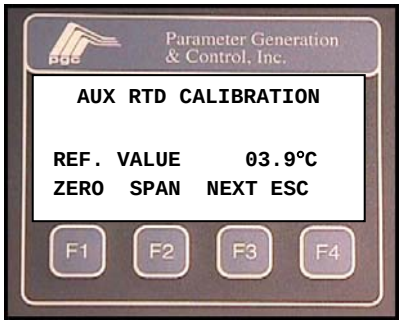
Key for function keys action

F1 = CAL: instructs the A/D converter to accept the new span value.
F2 = no function
F3 = no function
F4 = DONE: allows the user to exit the screen after the offset value has been accepted. Returns to the water RTD calibration screen

Aux RTD Calibration Screen (Steady State and Prog Modes)

A second RTD can be accessed for calibration from the SmartPad. This is an optional sensor that may not be present on every system. (Note that when the controller is configured for reactivation control in dry mode, this RTD will be the reactivation temperature sensor). The controller converts the auxiliary RTD resistance to a digital temperature measurement using a 16-bit A/D converter. The offset (zero) and scaling (span) of this A/D converter input can be adjusted from the SmartPad keypad. Refer to the system user manual for step by step procedures to make this adjustment.

REF. VALUE Enter the temperature that should be displayed by the water temperature measurement circuit.



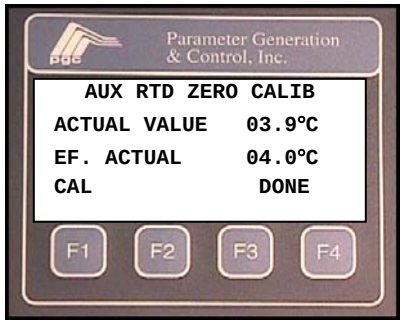
Key for function keys action
F1 = ZERO: access the zero adjust screen
F2 = SPAN: access the span adjust screen
F3 = NEXT: access other RTD calibrations
F4 = ESC: return to process variable

Aux RTD ZERO Calibration Screen (Steady State and Prog Modes)

The first step in calibrating the auxiliary RTD is to set the zero or offset value. This value should be as close as practical to the minimum operating temperature.

ACTUAL VALUE: will indicate the current auxiliary temperature, as it is measured by the input circuit. This value will change to indicate the calibration offset, after the CAL key is pressed.

REF. VALUE will indicate the reference value entered in the water RTD calibration screen



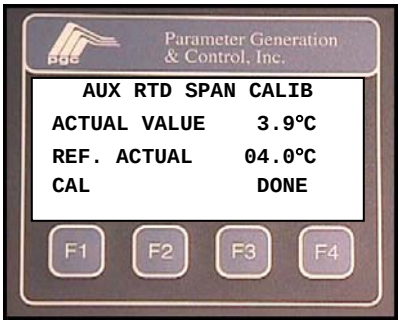
Key for function keys action
F1 = CAL: instructs the A/D converter to accept the new zero offset value.
F2 = no function
F3 = no function
F4 = DONE: allows the user to exit the screen after the offset value has been accepted. Returns to the auxillary RTD calibration screen

Aux RTD SPAN Calibration Screen (Steady State and Prog Modes)

After the auxiliary RTD zero adjustment it is necessary to adjust the span or scaling factor for the input. This adjustment will determine the slope of the calibration curve. This value should be as close as practical to the maximum operating temperature.

ACTUAL VALUE: will indicate the current water temperature, as it is measured by the input circuit. This value will change to indicate the calibration offset, after the CAL key is pressed.

REF. VALUE will indicate the reference value entered in the water RTD calibration screen



Key for function keys action

F1 = CAL: instructs the A/D converter to accept the new span value.
F2 = no function
F3 = no function
F4 = DONE: allows the user to exit the screen after the offset value has been accepted. Returns to the auxillary RTD calibration screen

Factory Configuration Menu (Steady State and Prog Modes)

Entering 7178 in the access code field will display the factory configuration menu. This menu will allow the user to re-configure the SmartPad™ for various operating modes and/or set point entry options.

The top line of the display will indicate the current operating mode.

The second line of the display is the current value that can be accessed.

The third line of the display is the current setting for the displayed value. Pressing CHNG (F3) will toggle the displayed value through all possible settings. The setting that is displayed is the setting that will become active.

Press ENTER (F4) to exit the alarm control menu and return to the process variable screen. This will cause the system to reboot in the mode selected.

Label Displayed	Acceptable Data Range	Description
CHOOSE CONTROL MODE	Rh Cascade Two Temp Dryer Slow Damper	Will reconfigure the SmartPad™ control mode. Use caution when changing modes. The operating mode is often hardware specific.
CHOOSE SP ENTRY MODE	Steady State Programmable	Will reconfigure the SmartPad™ set point entry mode. If a single condition is require, steady state is the most user-friendly mode. If multiple conditions that change automatically over time are required, programmable mode is required.

Alarm Control Menu (Steady State and Prog Modes)

Pressing ALRM in the area modification screen will access the alarm control menu. Inside this menu the user can step through a list of values that can be modified using the PREV (F1) and NEXT (F2) keys.

The top line of the display will indicate the current operating mode.

The second line of the display is the current value that can be accessed.

The third line of the display is the current setting for the displayed value. Pressing CHNG (F3) will toggle the displayed value through all possible settings. The setting that is displayed is the setting that will become active.

If a numerical value is displayed, time or alarm set points for example, enter a new value using the numerical keypad. As in all SmartPad™ data entry, you must fill the entire field before the information will be accepted.

Label Displayed	Acceptable Data Range	Description
GEN ALARM CONFIG	Alarms Disabled Alarms Enabled	Turns the alarm function on or off
GEN ALARM CONFIG Timer:	00:00:00 through 17:59:59	Alarm delay timer. This defines the time that an alarm condition will be ignored.
AIR ALARM CONFIG Trip by:	Limits Deviation	Defines the type of air alarm that will be used. Limits allow the user to set a fixed max/min temperature that will trigger an alarm. Deviation sets a range of temperatures, above and below the current set point that will trigger an alarm.
AIR ALARM CONFIG High Limit	Varies based on range of chamber or conditioner	Maximum limit for the air temperature alarm
AIR ALARM CONFIG Lo Limit	Varies based on range of chamber or conditioner	Minimum limit for the air temperature alarm
AIR ALARM CONFIG Deviation	0.1 to 99.9	Temperature range, above and below the current set point that will trigger an alarm. Useful when the set point is changing (programmable).
CH2 ALARM CONFIG Trip by:	Limits Deviation	Defines alarm type for channel 2 (water or Rh depending on control mode)
CH2 ALARM CONFIG High Limit	99.9%	Maximum limit for the channel 2 process variable.
CH2 ALARM CONFIG Lo Limit	0.0%	Minimum limit for the channel 2 process variable.
CH2 ALARM CONFIG Deviation	0.1 to 99.9	Channel 2 process variable range, above and below the current set point.

Tuning Control Menu (Steady State and Prog Modes)

Pressing TUNE in the area modification screen will access the tuning control menu. Inside this menu the user can step through a list of values that can be modified using the PREV (F1) and NEXT (F2) keys. The top line of the display will indicate the current operating mode. The second line of the display is the current value that can be accessed. The third line of the display is the current setting for the displayed value. Enter the new data using the numerical keypad. As in all SmartPad™ data entry, you must fill the entire field before the information will be accepted.

Press ESC (F4) to exit the tuning control menu and return to the process variable screen.

Label Displayed	Acceptable Data Range	Description
AIR HEATER CONTROL Control Band	00.00 to 99.99	Defines the proportion (P) portion of the air temperature control loop.
AIR HEATER CONTROL Rate	00.00 to 99.99	Defines the rate or integral (I) portion of the air temperature control loop.
AIR HEATER CONTROL Derivative	000 to 999	Defines the derivative (D) portion of the air temperature control loop.
AIR HEATER CONTROL Manual Adjust	00.00 to 99.99	Defines the air heater output balance point. In Slow Damper mode the damper control loop will integrate in an attempt to control the air temperature with an output percentage that is equal to the manual adjust setting.
AUX HEATER CONTROL Set Point	00.00 to 99.99	Allows access to the auxiliary heater control loop set point. * This set point can be configured to be slaved to the air set point.
AUX HEATER CONTROL Actual	00.00 to 99.99	Displays the measured temperature from the auxiliary RTD.
AUX HEATER CONTROL Output	00.00 to 99.99	Displays the percentage output (heater duty cycle) for the auxiliary control loop
AUX HEATER CONTROL Control Band	00.00 to 99.99	Defines the proportion (P) portion of the auxiliary temperature control loop.
AUX HEATER CONTROL Rate	00.00 to 99.99	Defines the rate or integral (I) portion of the auxiliary temperature control loop.
AUX HEATER CONTROL Derivative	000 to 999	Defines the derivative (D) portion of the auxiliary temperature control loop.
H2O HEATER CONTROL Control Band	00.00 to 99.99	Defines the proportion (P) portion of the water temperature control loop.
H2O HEATER CONTROL Rate	00.00 to 99.99	Defines the rate or integral (I) portion of the water temperature control loop.
H2O HEATER CONTROL Derivative	000 to 999	Defines the derivative (D) portion of the water temperature control loop.
RH CASCADE CONTROL Control Band	00.00 to 99.99	Defines the proportion (P) portion of the Rh cascade control loop.
RH CASCADE CONTROL Rate	0.000 TO 9.999	Defines the rate or integral (I) portion of the Rh cascade control loop. This value will determine the rate of change for the water set point.
RH CASCADE CONTROL H2O Hi Limit	00.00 to 99.99 (varies with hardware)	Defines the maximum water temperature set point that the system will allow. This value is hardware specific.

RH CASCADE CONTROL H2O Low Limit	00.00 to 99.99 (varies with hardware)	Defines the minimum water temperature set point that the system will allow. This value is hardware specific, but is usually set to prevent freezing.
DRY MODE REACT CONTROL REACT Hi Limit	00.00 to 99.99	Defines the maximum reactivation temperature set point that the system will allow.
DRY MODE REACT CONTROL REACT Low Limit	00.00 to 99.99	Defines the minimum reactivation temperature set point that the system will allow.
RH DRYER CONTROL Control Band	00.00 to 99.99	Defines the proportion (P) portion of the desiccant dryer control loop.
RH DRYER CONTROL Rate	00.00 to 99.99	Defines the rate or integral (I) portion of the desiccant dryer control loop.
RH DRYER CONTROL Derivative	000 to 999	Defines the derivative (D) portion of the desiccant dryer control loop.
AIR DAMPER CONTROL Control Band	00.00 to 99.99	Defines the proportion (P) portion of the air bypass damper control loop.
AIR DAMPER CONTROL Rate	00.00 to 99.99	Defines the rate or integral (I) portion of the air bypass damper control loop.

SET POINT ENTRY (Steady State Mode)

The SmartPad™ has been designed to be as user-friendly as possible. To enter the desired set point for the chamber, press the "**SP**" key to enter the Set Point Screen. This can be done from the Process Variable Screen. If the controller is displaying any screen other than the process variable screen, it will be necessary to press "**ESC**" to return to the process variable screen in order to access the set point screen. When the SmartPad™ displays the set point screen enter the new set point, no decimal required.

Note: Since there is no "**ENTER**" key, it is necessary to fill every digit in the field for proper entry. For example: 10.0°C would be entered as "**1**", "**0**", "**0**". If the field is not filled, the new set point will be ignored.
After the new set point has been entered, it is usually a good idea to return the controller to the process variable screen so that the process variables can be monitored.

NOTE - If lock out option "ALL" has been chosen from the configuration options screen, there will be no flashing cursor or "TAB" function, allowing viewing only of the set points.

SET POINT ENTRY (Programmable Mode)

The following sample program covers many of the different types of segments typically used. NOTE - Although segment 00 is functionally equivalent to the other segments, it should generally be avoided as the first segment in the program. Experience has shown that this segment is the most common segment to be changed inadvertently.

It is advisable to sketch out the program before attempting to enter the data into the SmartPad™. Sketching out the program serves several purposes; it helps to visualize the program, makes entering the data easier, and provides a record for future reference.

Programs consist of **ramps** and **dwells**, where a ramp is the time required for the set point to reach the desired value, and a dwell is the time that the set point will remain at that value. If you write your program with two different dwells immediately following each other, you will end up with a dwell and a ramp.

Note: There is no "**ENTER**" key; a field must be completely filled by entering numerals from the Number Pad.

WRITING THE PROGRAM ON PAPER

In this sample program it is assumed that slow damper cascade control mode is selected. If two-temperature control mode is selected H2O set point will be entered instead of % RH set point. **Example**: From the water spray/RH graph supplied with this unit, follow the desired dry bulb temperature (vertical lines) and Relative Humidity (horizontal lines). The intersection of these two lines defines the water spray temperature (curved lines) necessary to achieve the desired conditions.

SEGMENT 01:

1.) Time set in hours, minutes and seconds is the time to proceed to the conditions desired. *IMPORTANT* - Since the starting point of the SmartPad™ is unknown, program the time in the first segment of the program for a short interval, such as one second, to bring the SmartPad™ to a known starting value.

2.) Select the dry-bulb temperature at which the test is to start. Enter this temperature to 1/10 degree Centigrade on the programming sheet. For this example; 25 degrees Centigrade = 25.0.

3.) Select the desired Relative Humidity. Example: 45% RH.

SEGMENT 02: Program the same conditions as segment 01 with the time at 30 minutes. This will allow time for the conditioner to stabilize at 25.0°C and 45% RH.

SEGMENT 03: For the next condition in the test, we wish to hold the same dry-bulb temperature but raise the humidity from 45% to 55% in a controlled ramp. Allow 45 minutes for the unit to ramp the RH from 45% to 55%.

SEGMENT 04: We now wish to hold this condition for thirty minutes.

SEGMENT 05: The next condition desired is to raise the air temperature to 35 deg. C with a relative humidity of 60.5%. We will allow one hour and twenty minutes for this controlled ramp of both the air and RH to these new conditions.

SEGMENT 06: If desired, we may hold these conditions for a maximum of to 17 hours 59 minutes and 59 seconds. If a longer time is required two steps must be used. We will select 15 minutes.

SEGMENT 07: We now wish to ramp back down to our original conditions of 25 deg. C and 45% RH in 40 minutes.

SEG	TIME	AIR SET POINT	RH SET POINT
01	00 00 01	25.0	45.0
02	00 30 00	25.0	45.0
03	00 45 00	25.0	55.0
04	00 30 00	25.0	55.0
05	01 20 00	35.0	60.5
06	00 15 00	35.0	60.5
07	00 40 00	25.0	45.0

If it is desired to repeat this cycle, loop from segment 07 to segment 02. If it is desired to hold the conditions, loop from segment 07 to segment 07. It is advisable to note the start, loop from and loop to segments on the programming sheet; for this example program: start at segment 01, loop from segment 07 and loop to segment 02 or 07 as selected. This information will be entered on the "PROGRAM INITIALIZATION" screen.

This should give the operator the necessary information to write a simple program. After water has been turned on, wait until reservoir is filled before turning on the conditioner. The pump and water heater should NEVER be powered without water in the system.

ACTUAL LOADING OF THE PROGRAM

Set the Segment Time, Dry-Bulb Temperature and RH as follows:

NOTE - If lock out option "ALL" has been chosen from the configuration options screen, there will be no "TAB" function (F1) and no flashing cursor since you are allowed to view but not change the program.

1. From the "METER" screen press the "PROG" key, the display should change to the "PROGRAM" screen.

2. Segment 00 should show on the display, depress "NEXT" or 01 on the number pad. The display will now show the data for segment 01.

3. Notice that the data entry cursor is presently located in the Segment field. Data can only be entered into a field if the cursor is located in that field. Press the "TAB" key once, the first position of the "time" should start flashing.

4. On the number pad depress 00 00 01. The flashing portion of the display should have moved all the way through the time indication and back to the beginning. It is necessary to enter a digit for each character in every field that is to be changed. The data will be entered into memory as soon as the last digit is entered. If the time is correctly entered, depress the "TAB" key; if not simply reenter the correct time since the first digit is still flashing.

5. After pressing "TAB", the first digit of the "air set point" should be flashing. On the number pad depress 250. It is not necessary to enter the decimal point. The flashing portion of

the display should have moved all the way through the temperature indication and back to the beginning. If it is entered as desired, depress the "TAB" key.

6. The first digit of the "RH set point" should be flashing. On the number pad depress 450. It is not necessary to enter the decimal point. The flashing portion of the display should have moved all the way through the RH indication and back to the beginning. If it is entered as desired, depress the "TAB" key.

7. The first digit of the "segment" should be flashing. Depress the "NEXT" key. This should advance you to segment 02. NOTE - At this point you may depress any digits on the number pad to take you to any segment (00 to 59).

8. Enter segments 02 through 07 as above. Remember a field must be completely filled, and the flashing portion of the display returned to the beginning for the data you are entering to be accepted. If you leave a field by pressing any of the function keys before the field is filled, the previous data will remain in memory.

9. Press the "INIT" key, the screen will change to the "PROGRAM INITIALIZATION" screen.

10. The first digit of the "start at segment" should be flashing. On the number pad depress 01. The flashing portion of the display should have moved all the way through the indication and back to the beginning. If it is entered as desired, depress the "TAB" key.

11. The first digit of the "loop from segment" should be flashing. On the number pad depress 07. The flashing portion of the display should have moved all the way through the indication and back to the beginning. If it is entered as desired, depress the "TAB" key.

12. The first digit of the "loop to segment" should be flashing. On the number pad depress 02 or 07 as selected. The flashing portion of the display should have moved all the way through the indication and back to the beginning. If it is entered as desired, you MUST depress the "EXEC" key. This will input your new loop information, instruct the SmartPad™ to change to the "METER" screen, and the program will begin running at segment 01. If the time does not count down, you are in a "halt" condition, depress F1 to cause the program to "run".

VERIFYING THE PROGRAM

1. You may verify the program at any time. From the "METER" screen press the "PROG" key, the screen should change to the "PROGRAM" screen.

2. If the lock out function is set to "none", the first digit of the "segment" should be flashing. You may verify or modify the data in any segment at this time. Depress the "NEXT" key. This will advance you to segment 01. NOTE - At this point you may depress any digits on the number pad to take you to any segment (00 to 59). If the lock out function is set to "all", you will have to use the "NEXT" key to advance through the program, you will be able to look at the program but not modify it, you also will not be able to start or stop the program.

ADDITIONAL PROGRAMMING INFORMATION

If you enter 00 00 00 for time in any segment, the SmartPad™ will stop at, but not perform that segment. The time display will stop counting down, this is the indication that the SmartPad™ is in the "halt" mode. Press "RUN" to exit the "halt" mode and continue with the program.

If a segment must be longer than 17 hours, 59 minutes and 59 seconds for a ramp or dwell, the time must be spread out over more than one segment.

If power to the SmartPad™ is removed for less than ~20 minutes, a program cycle will resume from the point it was at when the unit was turned off or the power failed. If power is removed for more than ~20 minutes the SmartPad™ will restart as defined on the "PROGRAM INITIALIZATION" screen.

PGC SmartPad™ Serial Communications

The SmartPad™ is capable of communication with a remote terminal via RS-232 protocol. The connection is made at a DB-9 male connector on the cabinet.

I. OVERVIEW:

This section of the manual will explain the use and function of the communications feature. The SmartPad™ is capable of communication with a remote terminal via RS-232 protocol. Through this interface the user can modify the control set points or the tuning values. The user can also request the current set points, tuning values, percentage output or the measured process variables. This functionality will allow the user to collect performance data from the controller or store test procedures on a remote terminal. These stored test procedures can then be downloaded to the SmartPad™, giving the user unlimited programming capability.

A complimentary copy of SmartLog™ is available by request. SmartLog™ provides a Windows based platform for data collection, chamber control and real-time graphing.

II. HARDWARE CONNECTIONS:

Connect the remote terminal to the nine pin header on the back of the SmartPad™ or DB-9 Male connector on the cabinet. Maximum cable length should be limited to 50 feet with RS-232 protocol. The required connections are as follows.

Terminal #	Function
5	Common
2	Terminal Receive (data from SmartPad™)
3	Terminal Transmit (data to SmartPad™)

III. TERMINAL PROTOCOL:

Any terminal program or application that is capable of sending and receiving ASCII characters should be capable of communicating with the SmartPad™. All hardware handshaking should be disabled in the terminal since there are no hardware handshaking connections on the SmartPad™ connector. The command sample rate should also be limited to greater than 10 milliseconds between request commands (?) and 20 mS. between input commands (=).

The protocol settings on the terminal should be:

Baud rate:	9600
Parity:	None
Data Bits:	8
Stop Bits:	1
Soft flow control (XON/XOFF):	on
Hard flow control (RTS/CTS):	off
Carriage return translation:	none (CR = CR only)
Line feed translation:	strip (CR = CR only)
Line pacing (command frequency):	10 milliseconds or greater for requests, 20 mS or greater for inputs.
Local character echo:	off
Duplex:	full
Carrier detection:	do not abort if CD is lost (no hardware handshaking)

IV. TYPES OF COMMANDS:

The SmartPad™ will respond to two types of commands; requests and inputs. A request is a command that instructs the SmartPad™ to return a value to the terminal. An example of this is if the terminal were to request the current measured air temperature. An input is a command that instructs the SmartPad™ to accept the following data. For instance, if the terminal were to give the SmartPad™ a new air set point.

All commands are preceded by either a "?" for a Request or an "=" for an input. This is followed by a three-character command. A data string can follow inputs. Spaces, (<SP>) are required between the command and the data string, as well as between each individual data field, if more than one exists. Decimals and colons may be omitted or used if preferred. All commands must be followed by a carriage return. (<CR>). Uppercase and lowercase letters are equally valid. It is important to note that all data entered into the SmartPad™ is stored in non-volatile memory (EEProm). This type of memory has a finite limit to the number of write/erase cycles. This limit is vaguely in the 5-10,000-cycle range. This should more than exceed the life of the device for standard keyboard driven data entry. If, however, an automatic set point entry scheme is used the EEProm could easily be destroyed much faster. An example of this would be to develop a ramping controller driven by a remote terminal. This situation should be avoided.

Portions of the command line are optional. The required portion is listed in Bold type. When entering a numeric value, the delimiters (decimal points or colons) are optional.

Example:

To request the current Air Set point.

?AS is the same command as **?AS**p

?A is not the same command as **?AS**p or **?AS**

V. COMMANDS: REQUEST COMMANDS:

Command	Function
?OO<CR>	Returns current run state (**O**n/**O**ff request)
?CM<CR>	Returns current **C**ontrol **M**ode (Rh Cascade, Two Temp, etc.)
?SM<CR>	Returns current **S**et point entry **M**ode
?AP<CR>	Returns the current **A**ir **P**rocess variable (measured air temperature)
?AS<CR>	Returns the current **A**ir **S**et point
?AH<CR>	Returns **A**ir **H**alf proportional band
?AR<CR>	Returns **A**ir **R**eset rate
?AD<CR>	Returns **A**ir **D**erivative constant
?AO<CR>	Returns the percentage of **A**ir heat **O**utput
?XP<CR>	Returns the current au**X**iliary **P**rocess variable
?XS<CR>	Returns the current au**X**iliary **S**et point
?XH<CR>	Returns au**X**iliary **H**alf proportional band
?XR<CR>	Returns au**X**iliary **R**eset rate
?XD<CR>	Returns au**X**iliary **D**erivative constant
?XO<CR>	Returns the percentage of au**X**iliary heat **O**utput
?WP<CR>	Returns the current **W**ater **P**rocess variable (water temperature)
?WS<CR>	Returns the current **W**ater **S**et point
?WH<CR>	Returns **W**ater **H**alf proportional band
?WR<CR>	Returns **W**ater **R**eset rate
?WD<CR>	Returns **W**ater **D**erivative constant
?WO<CR>	Returns the percentage of **W**ater heat **O**utput

The following commands are available in a Cascade mode only.

?WL<CR>	Returns **W**ater **L**ow limit
?WU<CR>	Returns **W**ater **U**pper limit
?RP<CR>	Returns the current **R**h **P**rocess variable (measured rh)
?RS<CR>	Returns the current **R**h **S**et point
?RH<CR>	Returns **R**h **H**alf proportional band
?RR<CR>	Returns **R**h **R**eset rate (maximum rate of change in water set point; degrees C per minute)
?RD<CR>	Returns **R**h **D**erivative constant

The following commands are available in Dryer mode only. (If machine is equipped with dryer)

?RO<CR>	Returns **R**h dryer **O**utput percentage

The following commands are available in Slow Damper mode only.

?DH<CR>	Returns **D**amper **H**alf proportional band
?DR<CR>	Returns **D**amper **R**eset rate
?DO<CR>	Returns **D**amper **O**utput percentage

The following commands are available in programmable modes only.

?PR<SP>xx<CR> **response:** *xx,Saa.aa,Sww.ww,hh:mm:ss*
Returns the **PR**ogram data for the segment (xx) requested. [aa.aa is air set point, ww.ww is water or Rh set point (Channel 2), and hh:mm:ss is the time entered in that segment]

?LUP<CR> **response:** *xx,yy,zz*
Returns the loop (**LUP**) parameters. [xx is start segment, yy is loop from segment, and zz is loop to segment]

?SY<CR> **response:** *run condition (run or halt), segment number, segment time*
Returns the **SY**stem status.

INPUT COMMANDS:

(Note: Sign byte is optional on inputs. Set point input commands may only be used in steady state modes)

Command	Function
=OO<CR>	Toggles current run state (**O**n/**O**ff command)
=RC<CR>	Instructs Smart Pad to reboot in **R**h **C**ascade control mode
=TT<CR>	Instructs Smart Pad to reboot in **T**wo **T**emperature control mode
=DY<CR>	Instructs Smart Pad to reboot in **D**ryer control mode
=SD<CR>	Instructs Smart Pad to reboot in **S**low **D**amper control mode
=SS<CR>	Instructs Smart Pad to reboot in **S**teady **S**tate set point entry mode
=PG<CR>	Instructs Smart Pad to reboot in **P**ro**g**rammable set point entry mode
=AS<SP>xx.xx<CR>	Inputs xx.xx as the new **A**ir **S**et point
=AH<SP>xx.xx<CR>	Inputs xx.xx as the new **A**ir **H**alf proportional band
=AR<SP>xx.xx<CR>	Inputs xx.xx as the new **A**ir **R**eset rate
=AD<SP>xxx<CR>	Inputs xxx as the new **A**ir **D**erivative constant
=XS<SP>xx.xx<CR>	Inputs xx.xx as the new au**X**iliary **S**et point
=XH<SP>xx.xx<CR>	Inputs xx.xx as the new au**X**iliary **H**alf proportional band
=XR<SP>xx.xx<CR>	Inputs xx.xx as the new au**X**iliary **R**eset rate
=XD<SP>xxx<CR>	Inputs xxx as the new au**X**iliary **D**erivative constant

The following command is available in Two Temperature mode only.

=WS<SP>xx.xx<CR>	Inputs xx.xx as the new **W**ater **S**et point
=WR<SP>xx.xx<CR>	Inputs xx.xx as the new **W**ater **R**eset rate
=WH<SP>xx.xx<CR>	Inputs xx.xx as the new **W**ater **H**alf proportional band
=WD<SP>xx.xx<CR>	Inputs xx.xx as the new **W**ater **D**erivative constant

The following commands are available in a Cascade mode only.

=WL<SP>xx.x<CR>	Inputs xx.x as the new **W**ater **L**ower limit
=WU<SP>xx.x<CR>	Inputs xx.x as the new **W**ater **U**pper limit
=RS<SP>xx.xx<CR>	Inputs xx.xx as the new **R**h **S**et point
=RH<SP>xx.xx<CR>	Inputs xx.xx as the new **R**h **H**alf proportional band
=RR<SP>x.xxx<CR>	Inputs x.xxx as the new **R**h **R**eset rate
=**RD**<SP>xxx<CR>	Inputs xxx as the new **R**h **D**erivative constant

The following commands are available in Slow Damper mode only.

=DH<SP>xx.xx<CR>	Inputs xx.xx as the new **D**amper **H**alf proportional band
=DR<SP>x.xxx<CR>	Inputs x.xxx as the new **R**h **R**eset rate

The following commands are available in programmable modes only.

=GO<CR>	Instructs the program to run/resume
=ST<CR>	Instructs the program to halt
=LUP<SP>xx<SP>yy<SP>zz<CR>	Inputs xx,yy,zz as the new loop (**LUP**) parameters [start seg; loop from seg; loop to seg] This command will also reinitialize the loop at the new loop parameters.
=PR<SP>xx<SP>aa.a<SP>ww.w<SP>hh:mm:ss<CR>	Inputs the **PR**ogram data, air (aa.a) and water (ww.w) set points and time (hh:mm:ss), for the segment indicated (xx).
=IN<CR>	Instructs the program to re**IN**itialize the loop at the existing loop parameters.

VI. TROUBLESHOOTING:

There are many possible hurdles that can prevent valid data transfer from the SmartPad™ to a remote terminal and vice-versa. Here is a partial discussion of potential problems and a recommended correction for the problem:

When the SmartPad™ is powered up it will transmit a log-on header via the RS-232 port. This header will clear the terminal screen and display the software version number, chamber serial number, and the current mode of operation.

P. G. C INC. **SERIAL #**
SOFTWARE VER. X.XXX
OPERATING MODE

If this log-on screen does not appear:

1.) Verify that the cable is connected properly and the pin out is correct per section II.
2.) Verify the terminal protocol values listed in section III.

If the log-on screen does appear but no characters are echoed from the SmartPad™ to the terminal:

1.) Verify the carriage return and line feed translations in the terminal program per section III.
2.) Attach a temporary grounding conductor from the remote terminal DB-9 connector to the ground connection on the SmartPad™ 6-position screw terminal strip. (Ground is the terminal next to the board mounting nut.) If this solves the problem it indicates that there is a difference in potential between the SmartPad™ common and the machine common. This is typically only a problem when the SmartPad™ is mounted remotely. To solve this connect a permanent ground from the SmartPad™ to the cabinet where the terminal connector is mounted.

Invalid characters are displayed on the terminal when the SmartPad™ is powered up.

1.) Verify that the cable is connected properly and the pin out is correct per section II.
2.) Verify the terminal protocol values listed in section III.

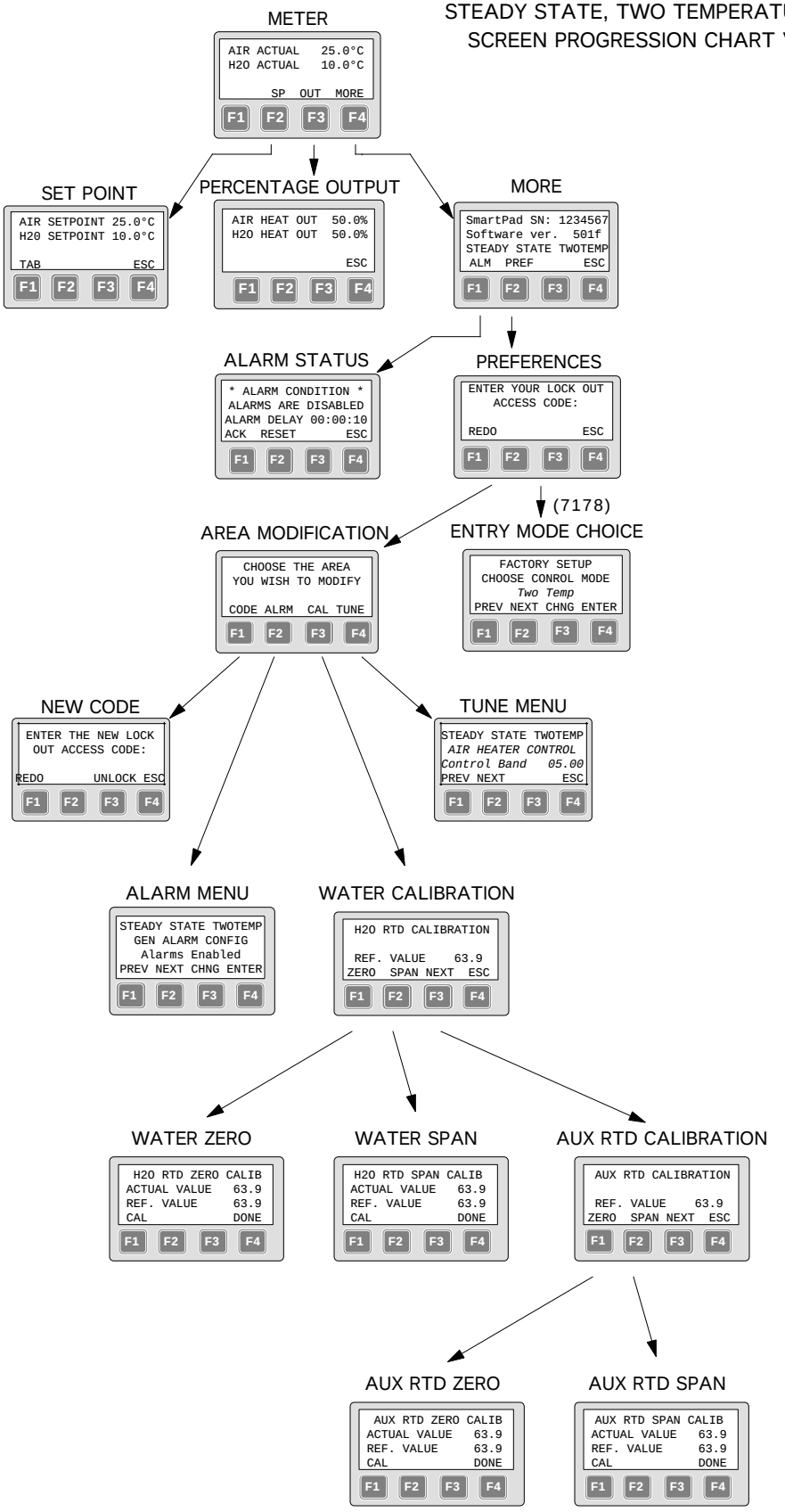
“INVALID REQUEST” is returned by the SmartPad™.

1.) A request or an input command has been used that is not active in the current mode. Either change modes use a different command.
2.) A request or an input command has not been entered properly. Verify that all of the necessary characters are present. Verify that the required spaces inserted correctly. Note that decimals and colons are optional. Also note that if an input command is not complete it will not be valid.

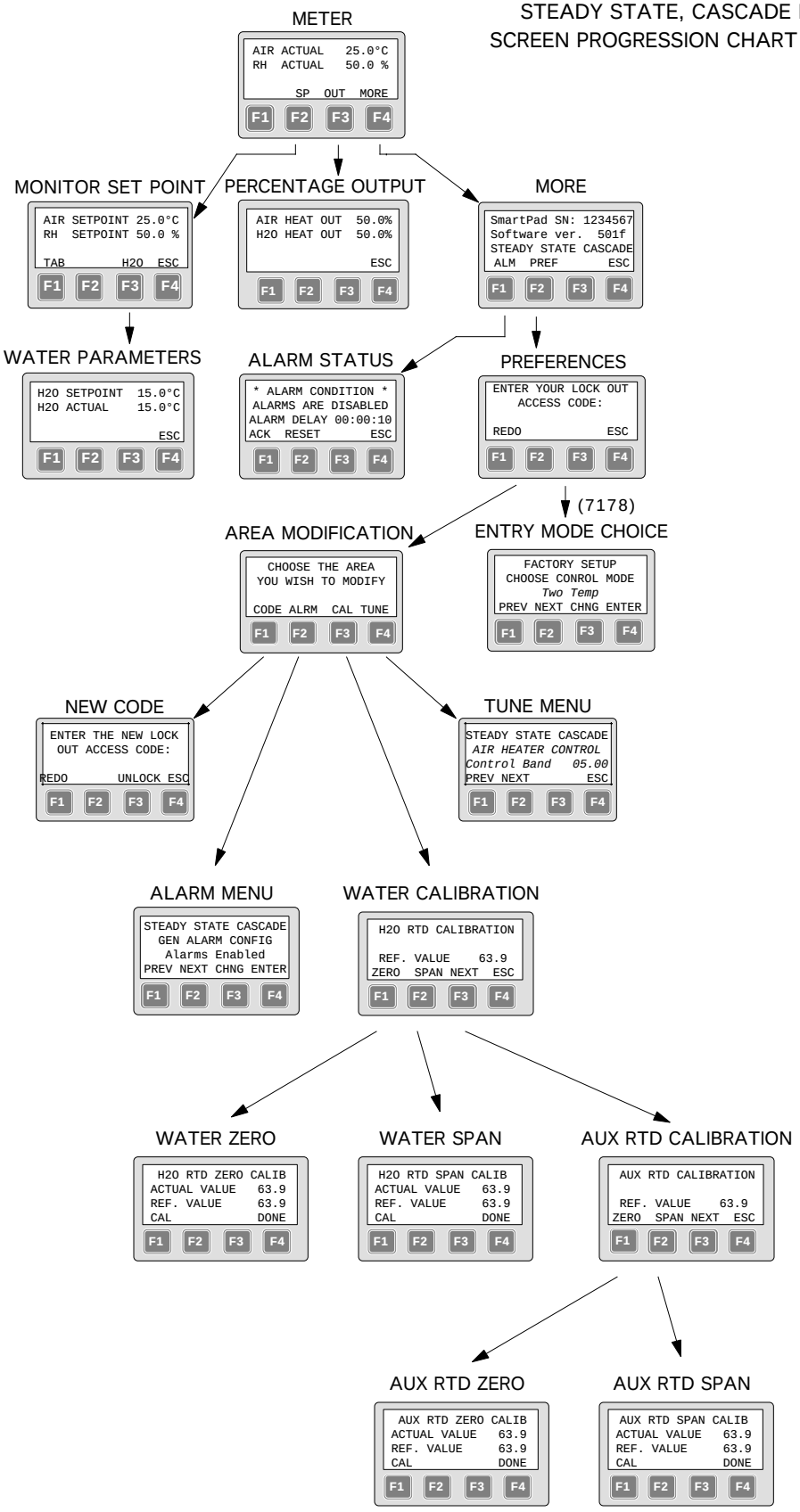
An input command is entered correctly but the data is not accepted.

1.) This typically means that the data entered exceeds the valid range of the field it has been entered in to. For instance, a standard machine might have an air set point range of 04.0°C to 86.0°C. If 02.0°C were entered it would be ignored.

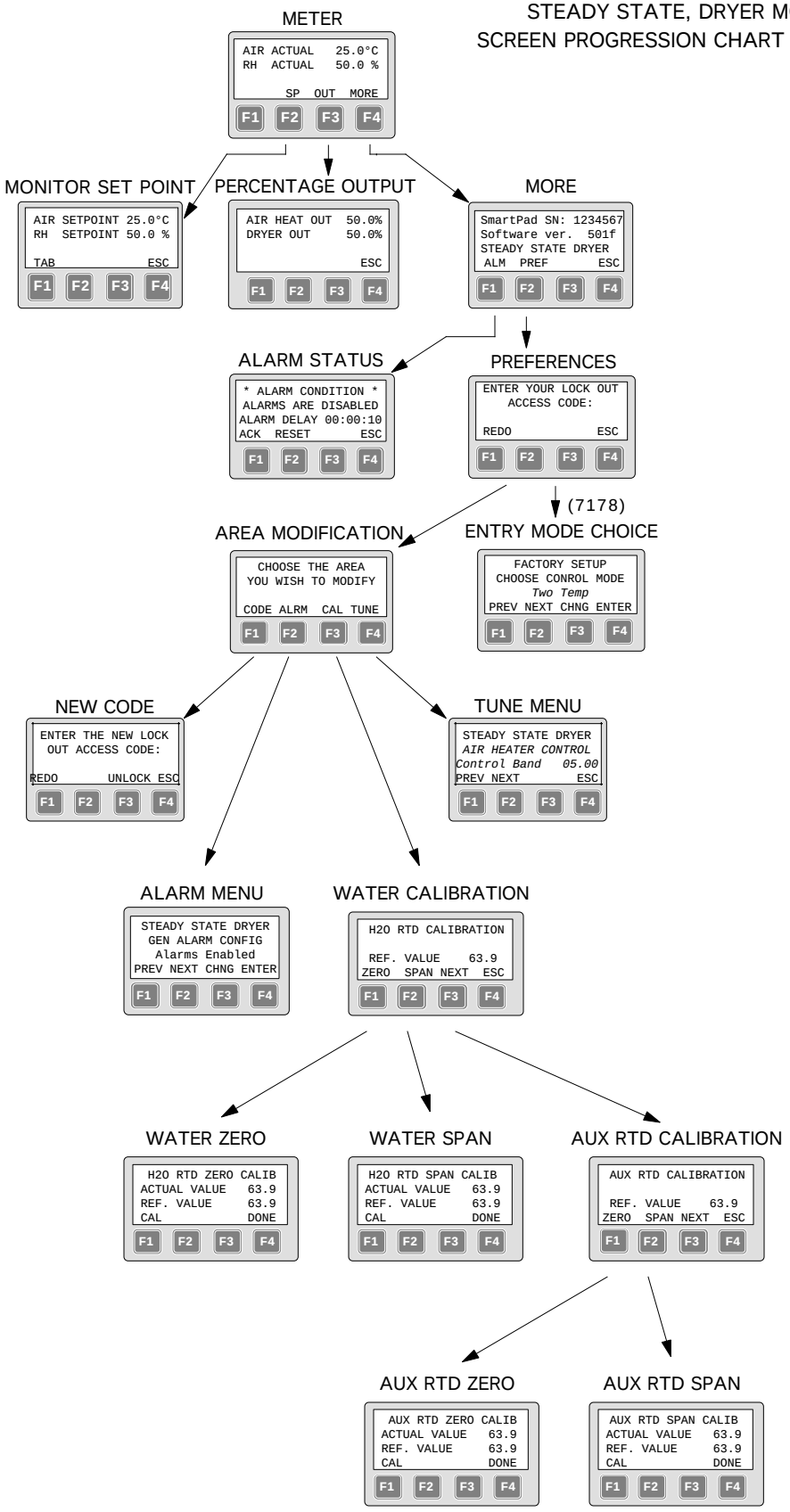
STEADY STATE, TWO TEMPERATURE MODE
SCREEN PROGRESSION CHART VER 503



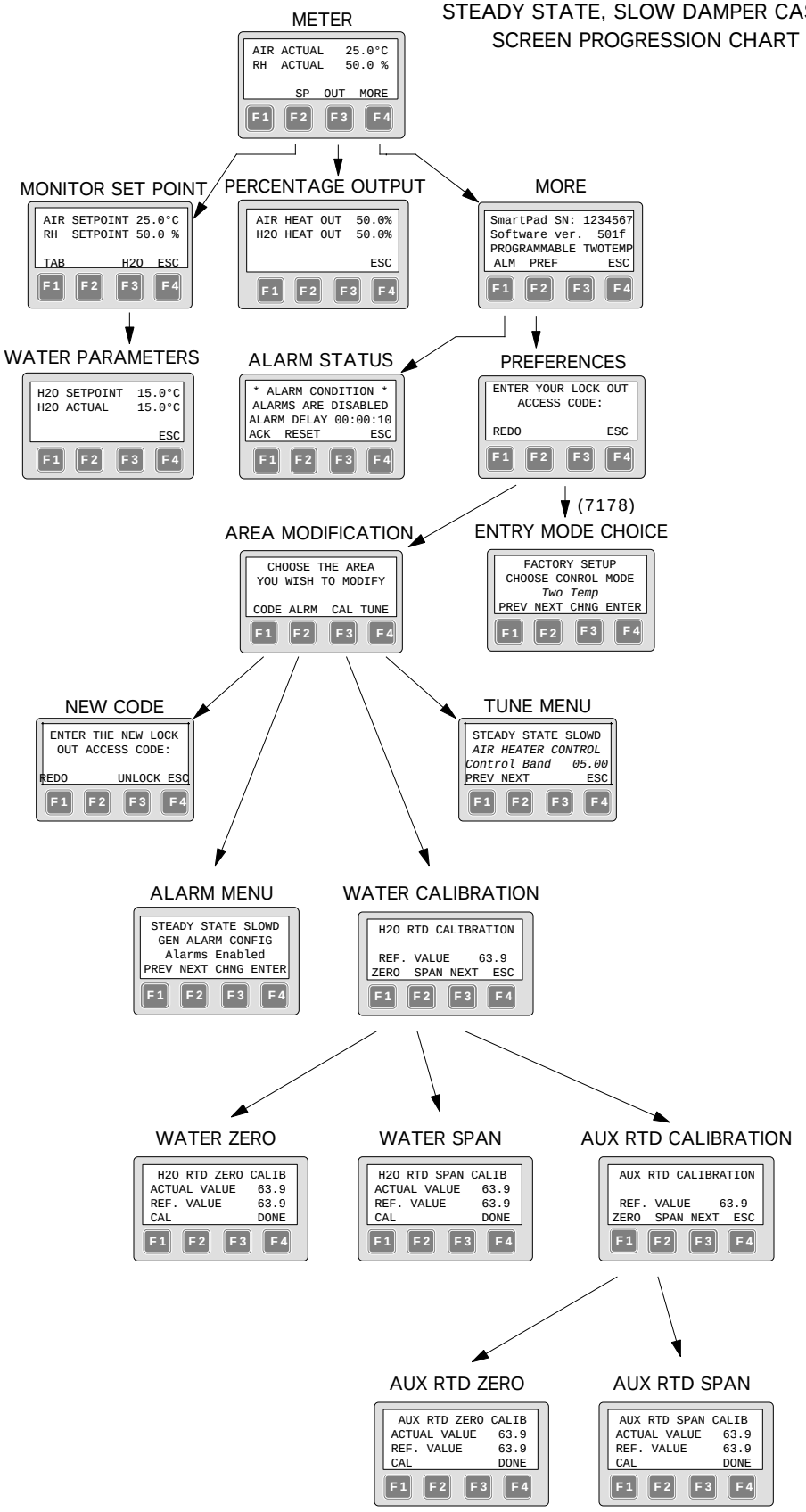
STEADY STATE, CASCADE MODE
SCREEN PROGRESSION CHART VER 503



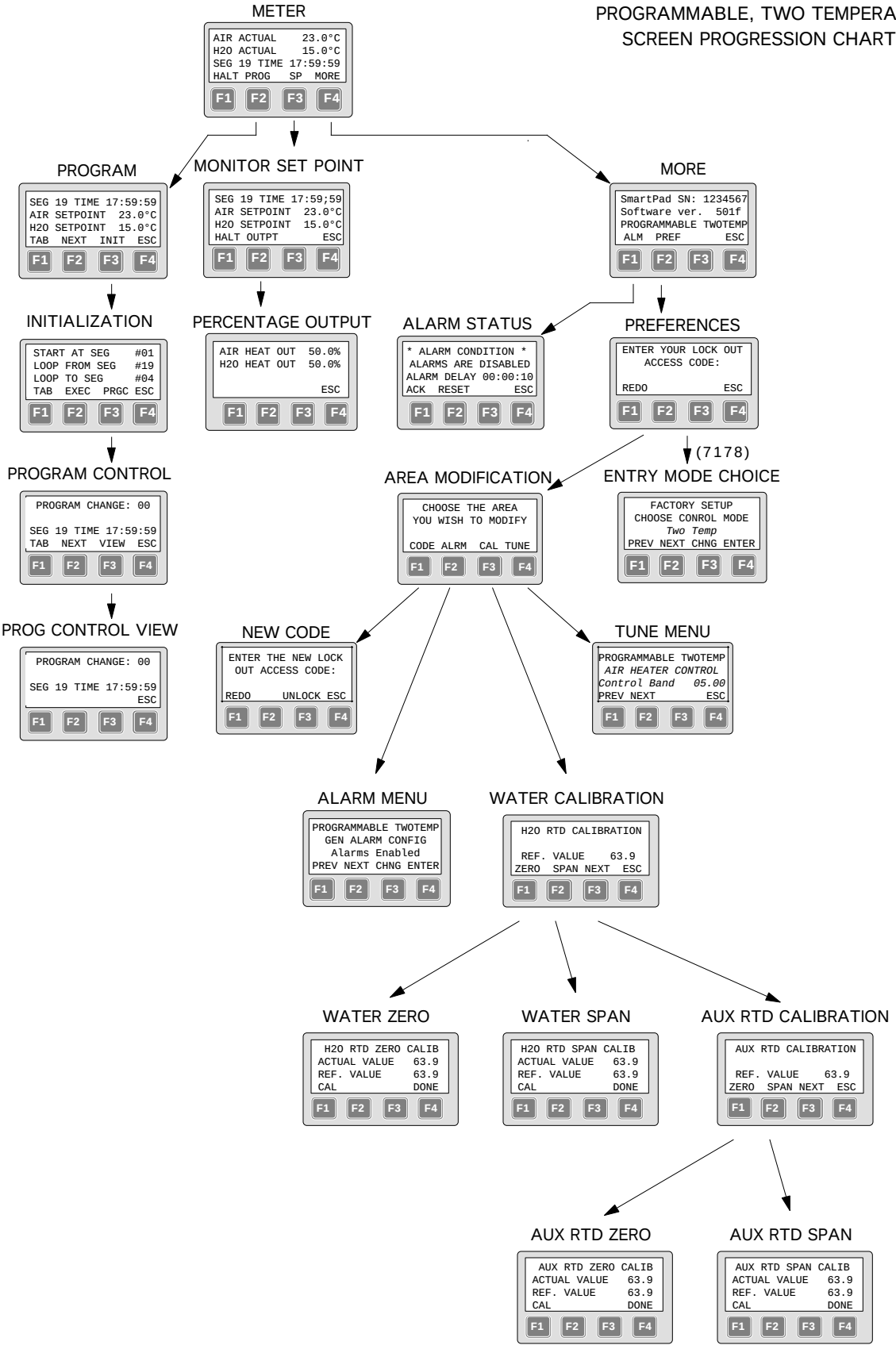
STEADY STATE, DRYER MODE
SCREEN PROGRESSION CHART VER .503



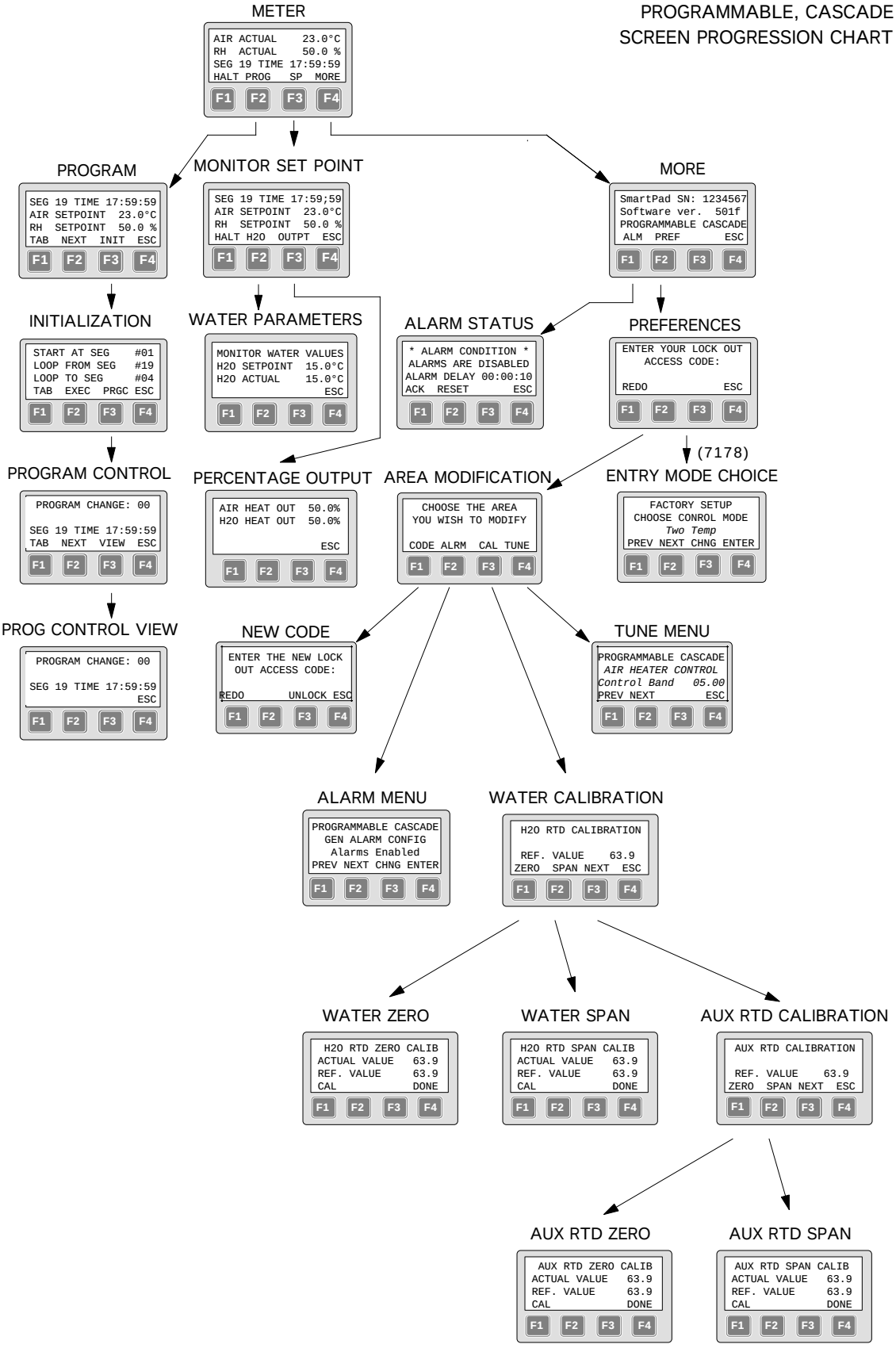
STEADY STATE, SLOW DAMPER CASCADE MODE
SCREEN PROGRESSION CHART VER 503



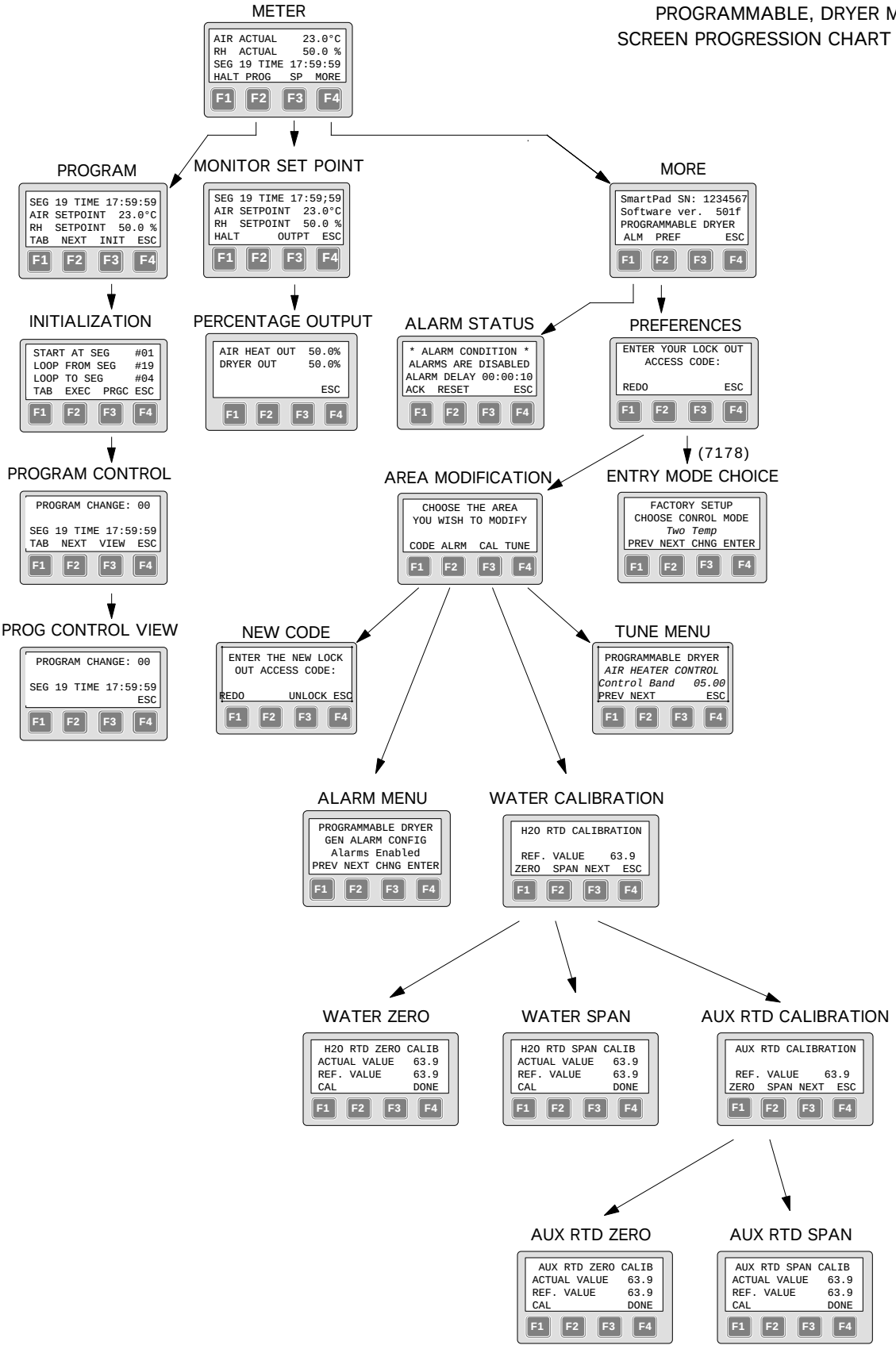
PROGRAMMABLE, TWO TEMPERATURE MODE
SCREEN PROGRESSION CHART VER 503



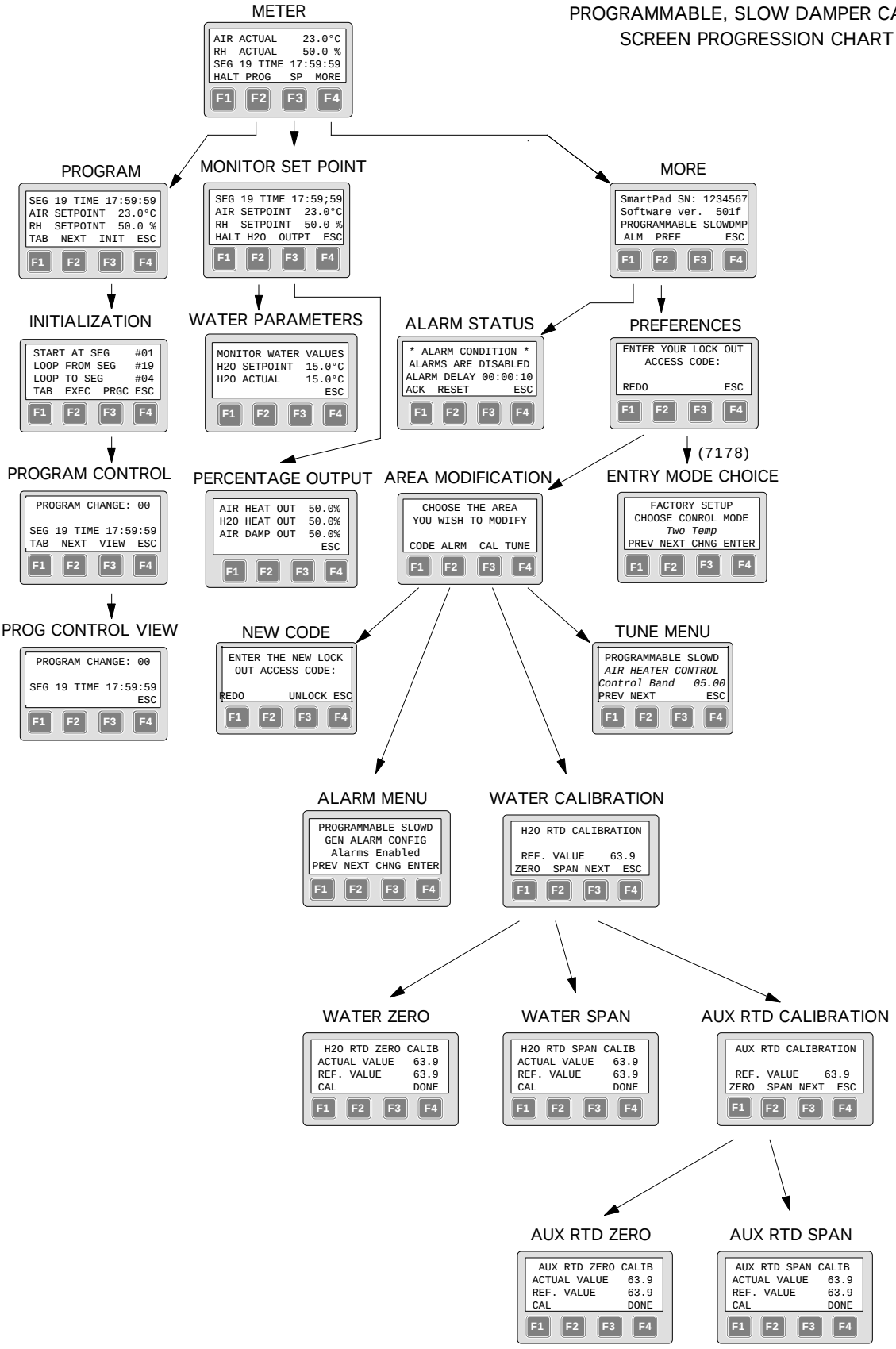
PROGRAMMABLE, CASCADE MODE
SCREEN PROGRESSION CHART VER 503



PROGRAMMABLE, DRYER MODE
SCREEN PROGRESSION CHART VER .503

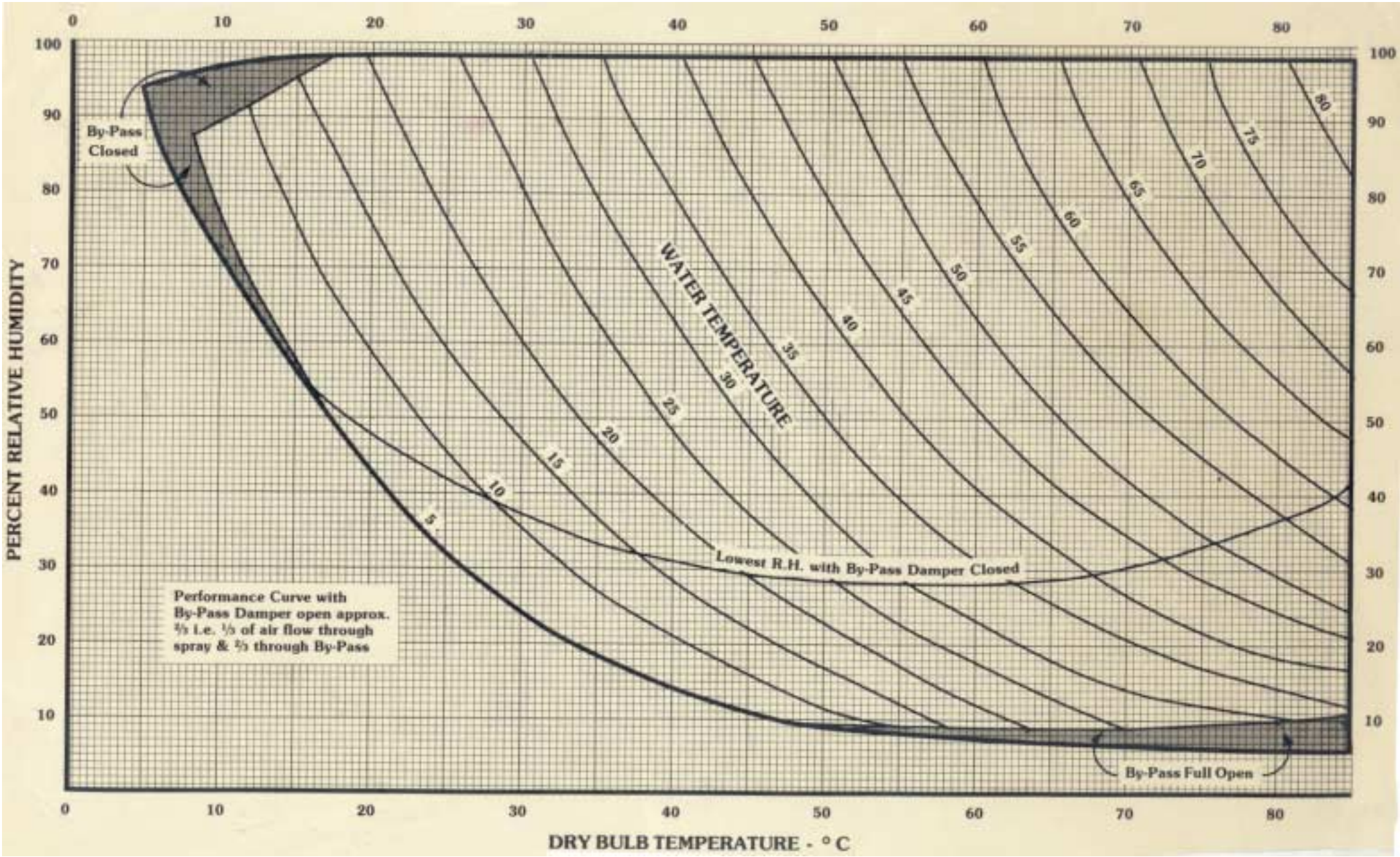


PROGRAMMABLE, SLOW DAMPER CASCADE MODE
SCREEN PROGRESSION CHART VER 503



Notes:

www.humiditycontrol.com (800) 438-5494
sales@humiditycontrol.com Fax (828) 669-6928 (828) 669-8717
Black Mountain, North Carolina


PERCENT RELATIVE HUMIDITY
DRY BULB TEMPERATURE - °C
WATER TEMPERATURE
By-Pass Closed
By-Pass Full Open
Lowest R.H. with By-Pass Damper Closed
Performance Curve with By-Pass Damper open approx. ⅔ i.e. ⅓ of air flow through spray & ⅔ through By-Pass
0
10
20
30
40
50
60
70
80
90
100
5
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15
20
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45
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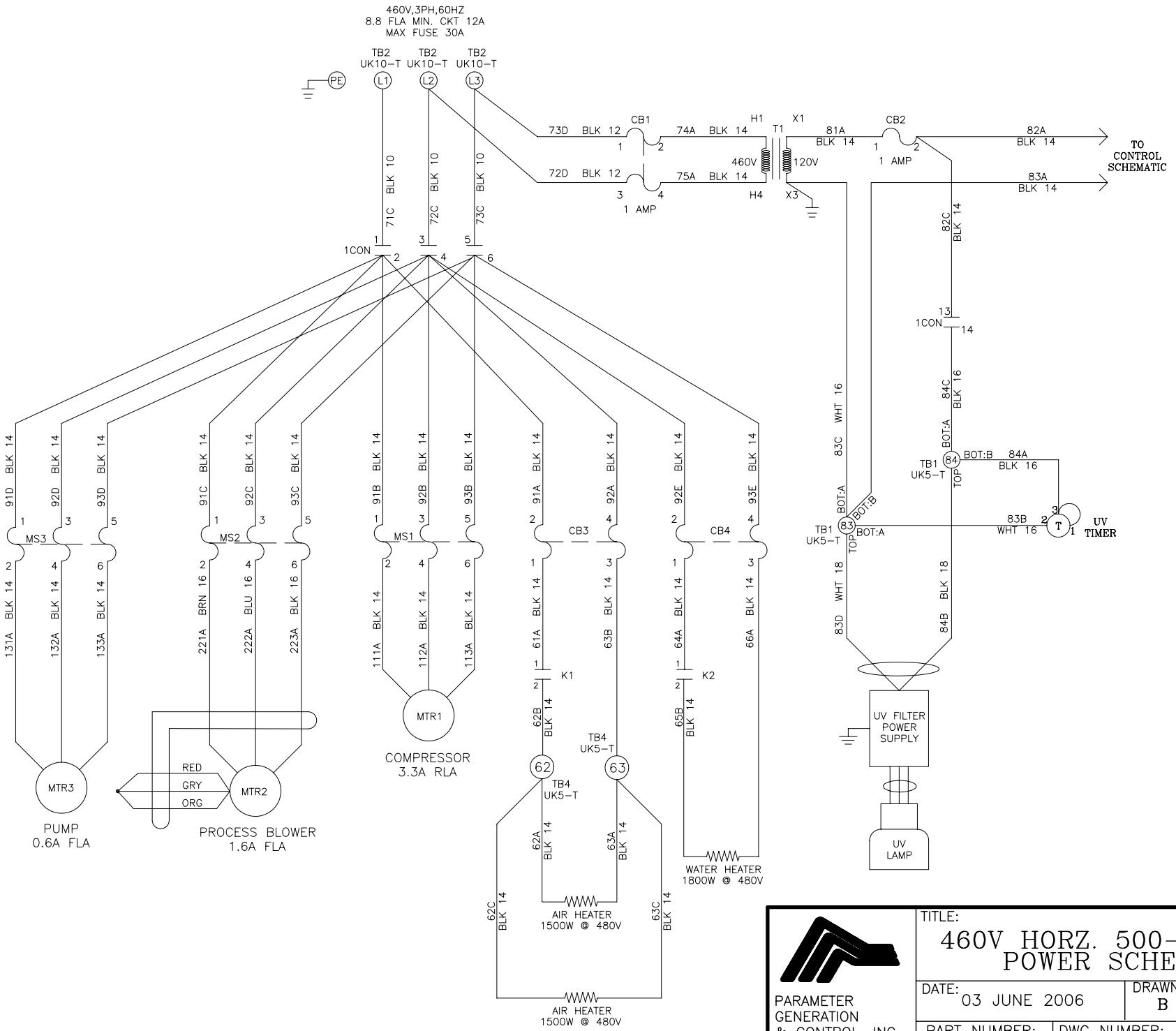
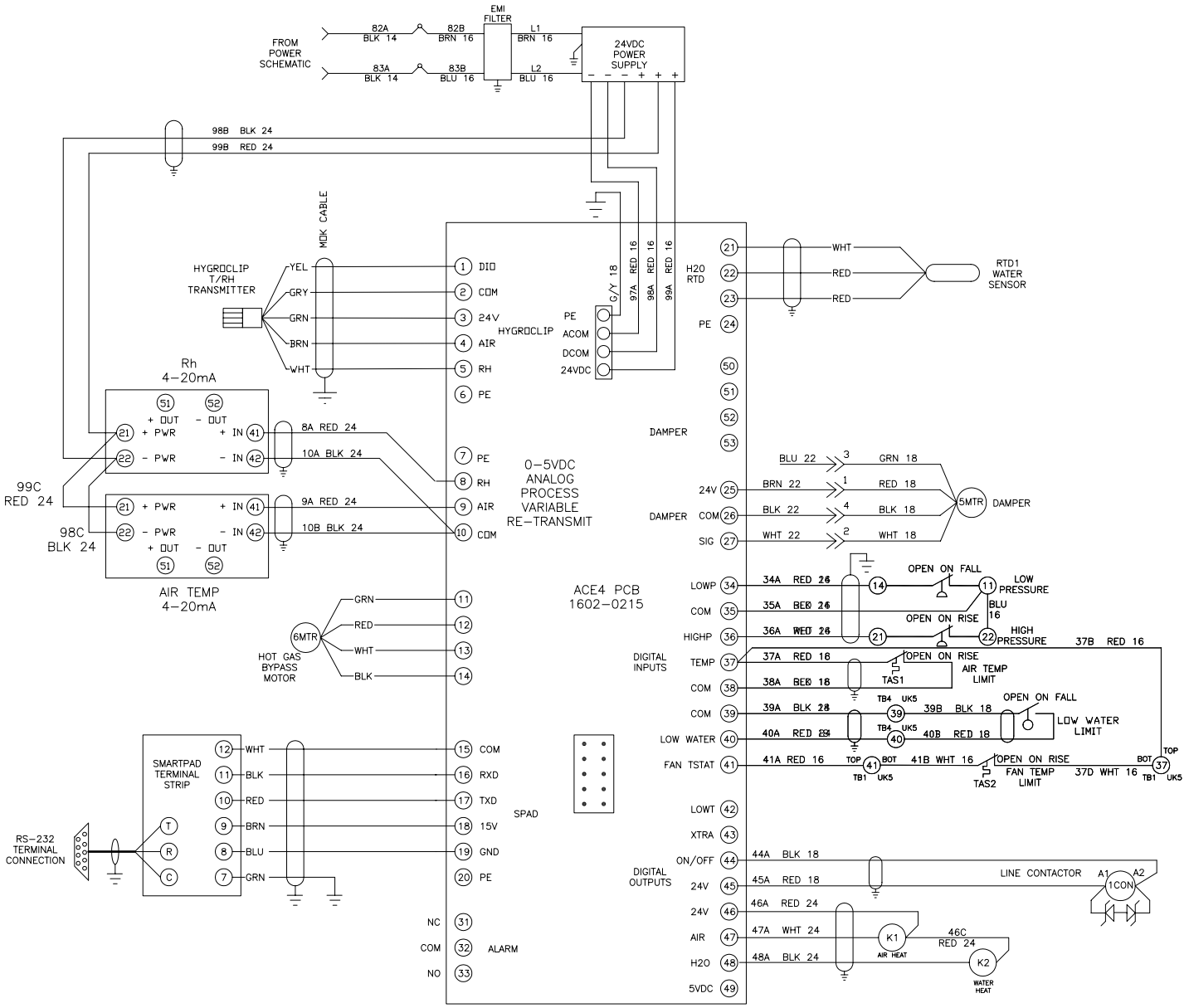
65
70
75
80



PARAMETER GENERATION & CONTROL, INC.
(828) 669-8717

TITLE:
460V HORZ. 500-1000 CFM POWER SCHEMATIC

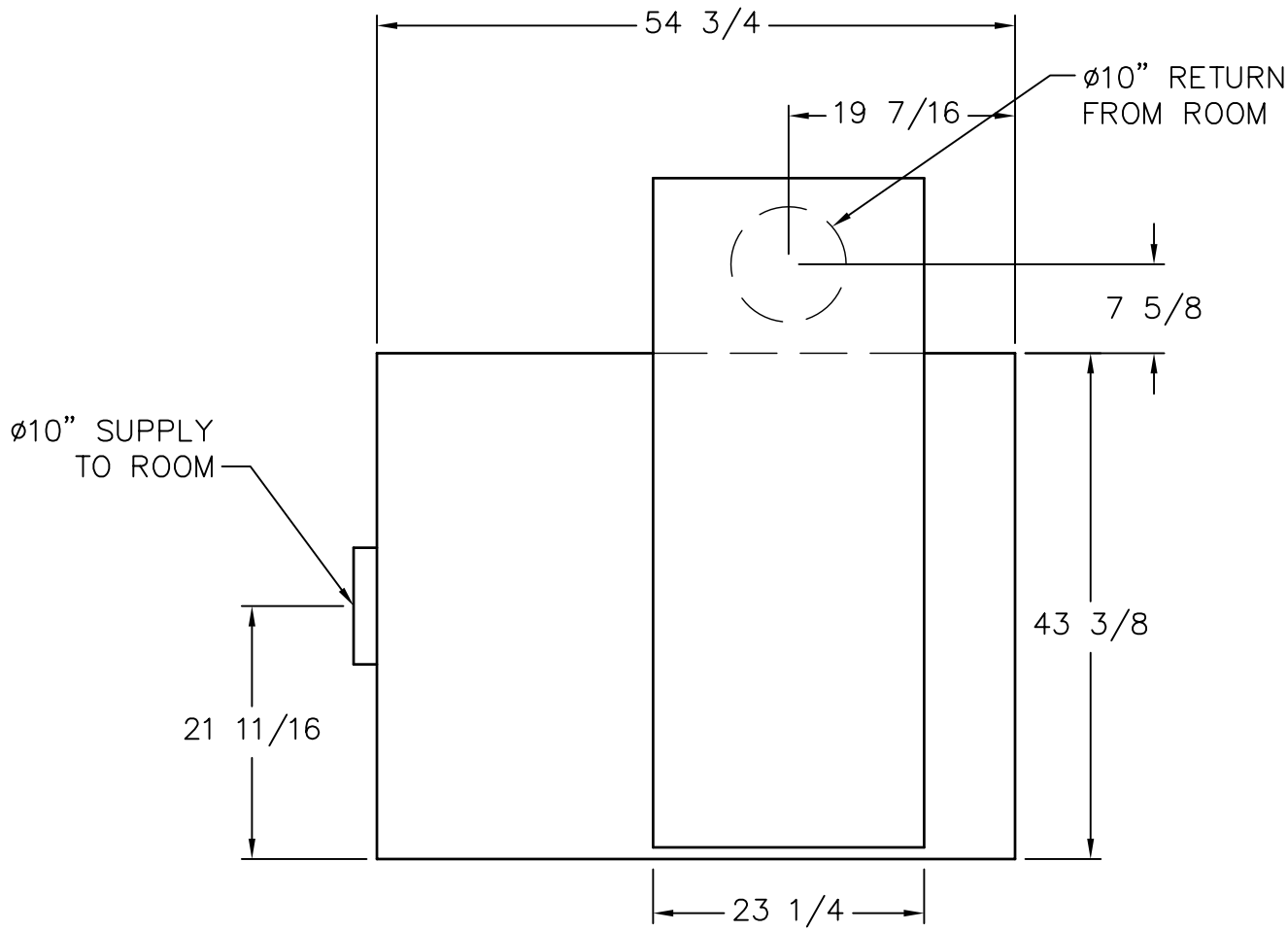
DATE:	DRAWN BY:	
03 JUNE 2006	B WILSON	
PART NUMBER:	DWG NUMBER:	JOB #
N/A	S12682-03 REV A	XXXX-XX



PARAMETER GENERATION & CONTROL, INC.
(828) 669-8717

TITLE:
HORIZONTAL 500-1000 CFM ACE4 CONTROL SCHEM.

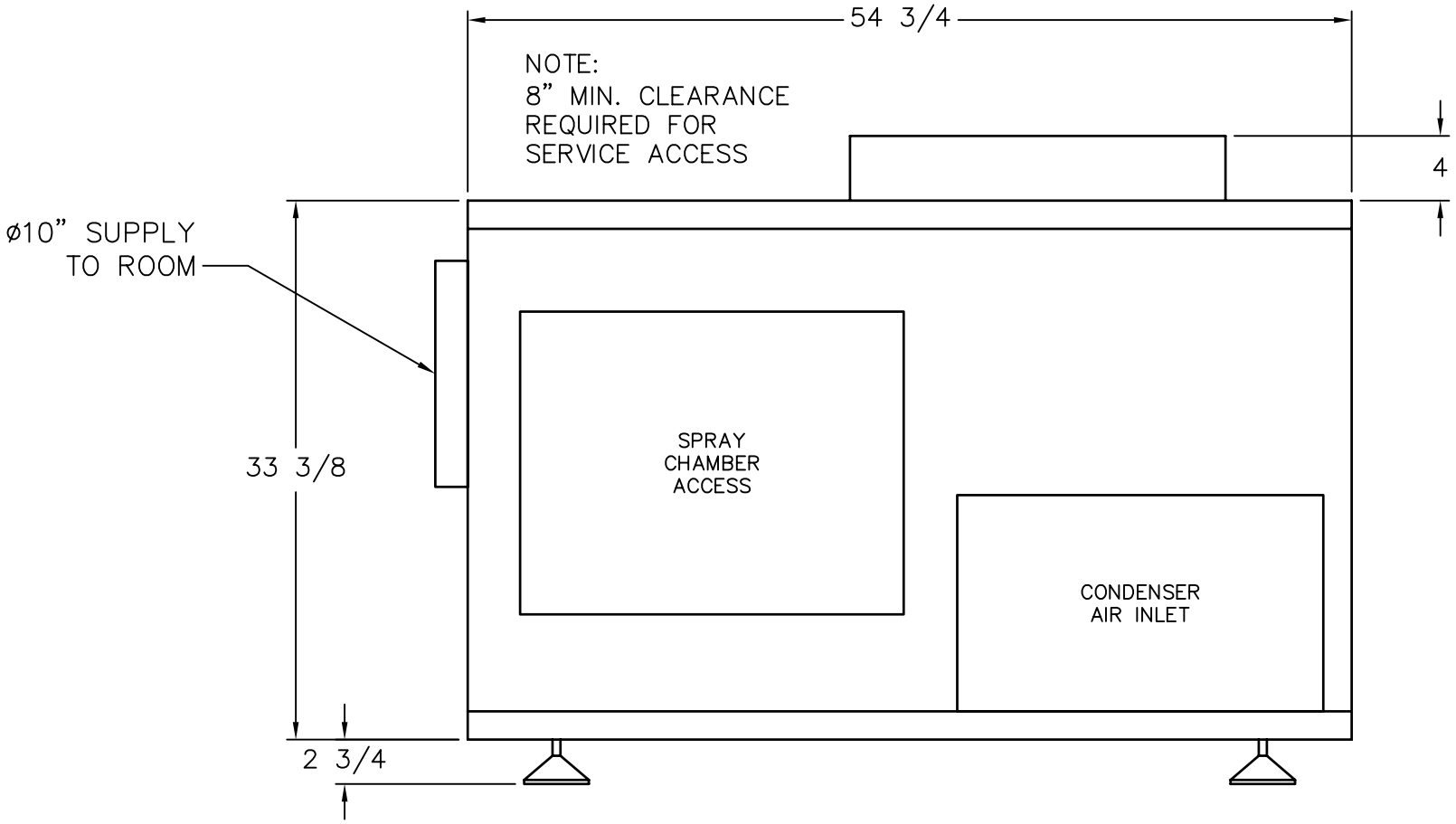
DATE:	DRAWN BY:	
2 JUNE 2006	B WILSON	
PART NUMBER: N/A	DWG NUMBER: S12682-04 REV A	JOB # XXXX-XX



PARAMETER
GENERATION
& CONTROL, INC.
(828) 669-8717

TITLE: 500-1000CFM AIR COOLED CONDITIONER TOP VIEW

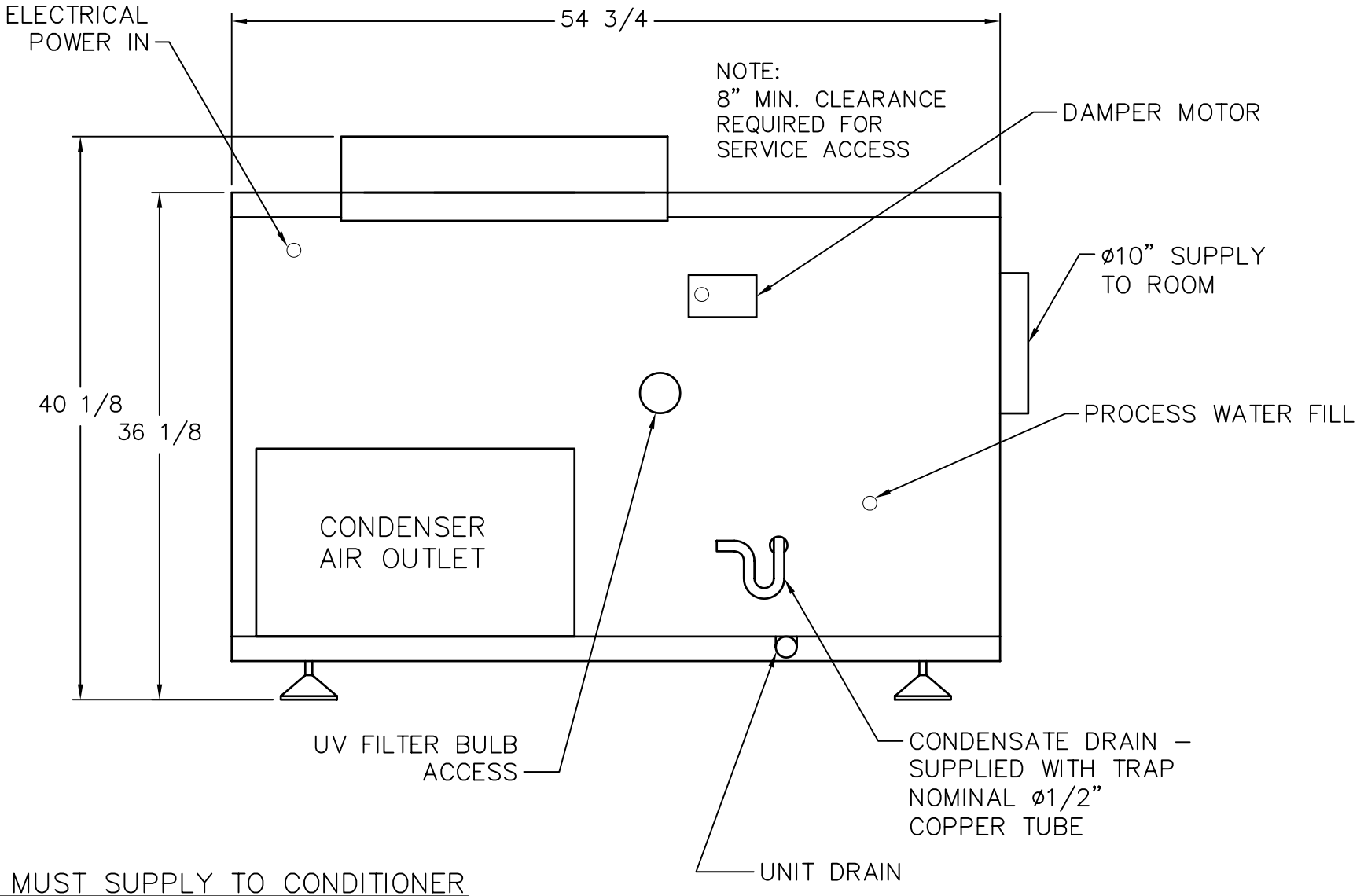
DATE:	DRAWN BY:	
04-14-06	RICK SPERRY	
PART NUMBER: 9354-2150	DWG NUMBER: 9354-2150-01	JOB # JOB#



PARAMETER
GENERATION
& CONTROL, INC.
(828) 669-8717

TITLE: 500-1000CFM AIR COOLED CONDITIONER FRONT VIEW

DATE:	DRAWN BY:	
04-14-06	RICK SPERRY	
PART NUMBER: 9354-2150	DWG NUMBER: 9354-2150-02	JOB # JOB#



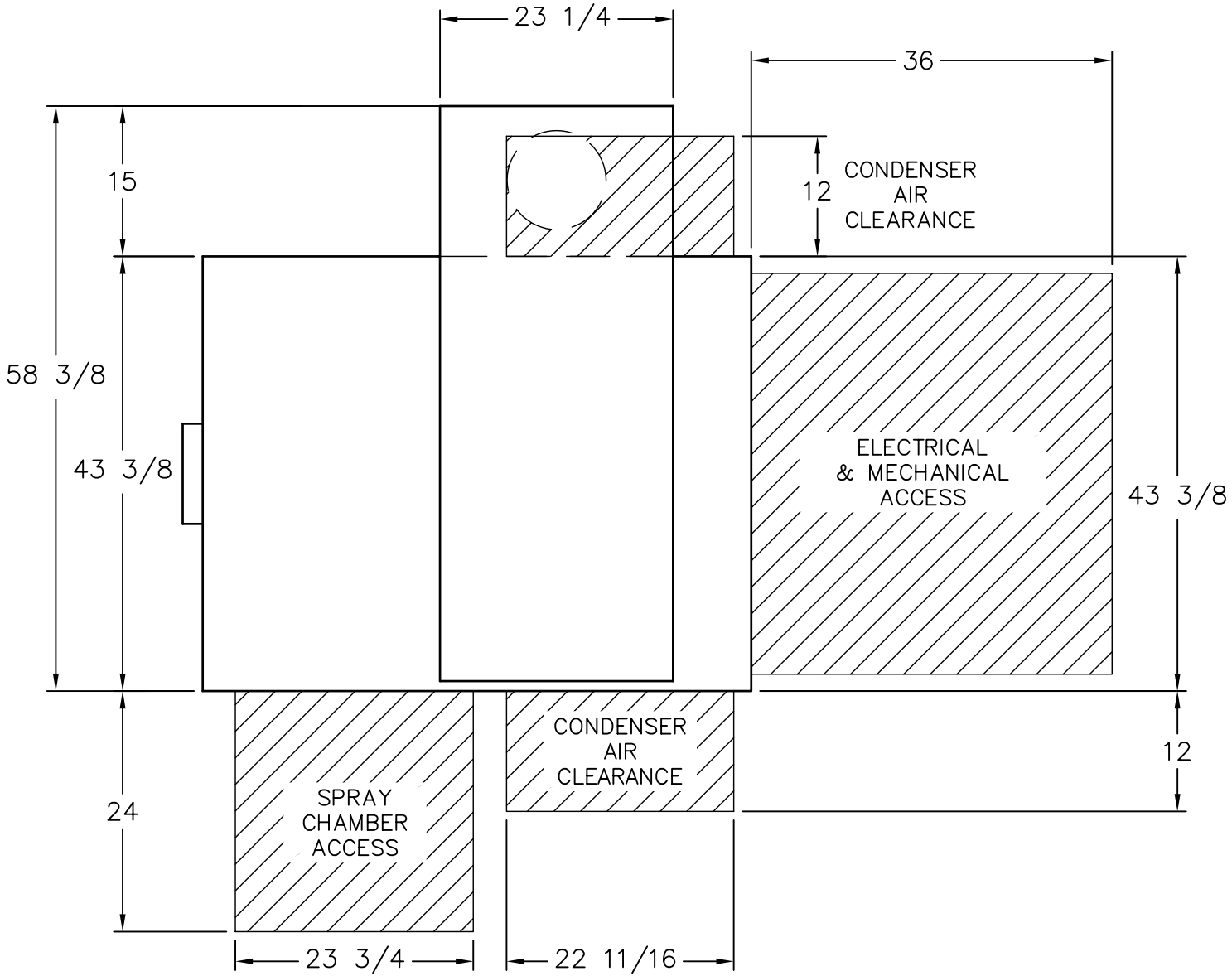
CUSTOMER MUST SUPPLY TO CONDITIONER

1. ELECTRICAL CONNECTIONS TO CONDITIONER
2. PROCESS WATER IN CONNECTIONS TO CONDITIONER
3. MUST PROVIDE AND INSTALL ELECTRICAL CONDUIT TO CONTROL BOX LOCATION
4. CONDENSATE AND UNIT DRAIN CONNECTIONS

PARAMETER
GENERATION
& CONTROL, INC.
(828) 669-8717

TITLE: 500–1000CFM AIR COOLED CONDITIONER REAR VIEW

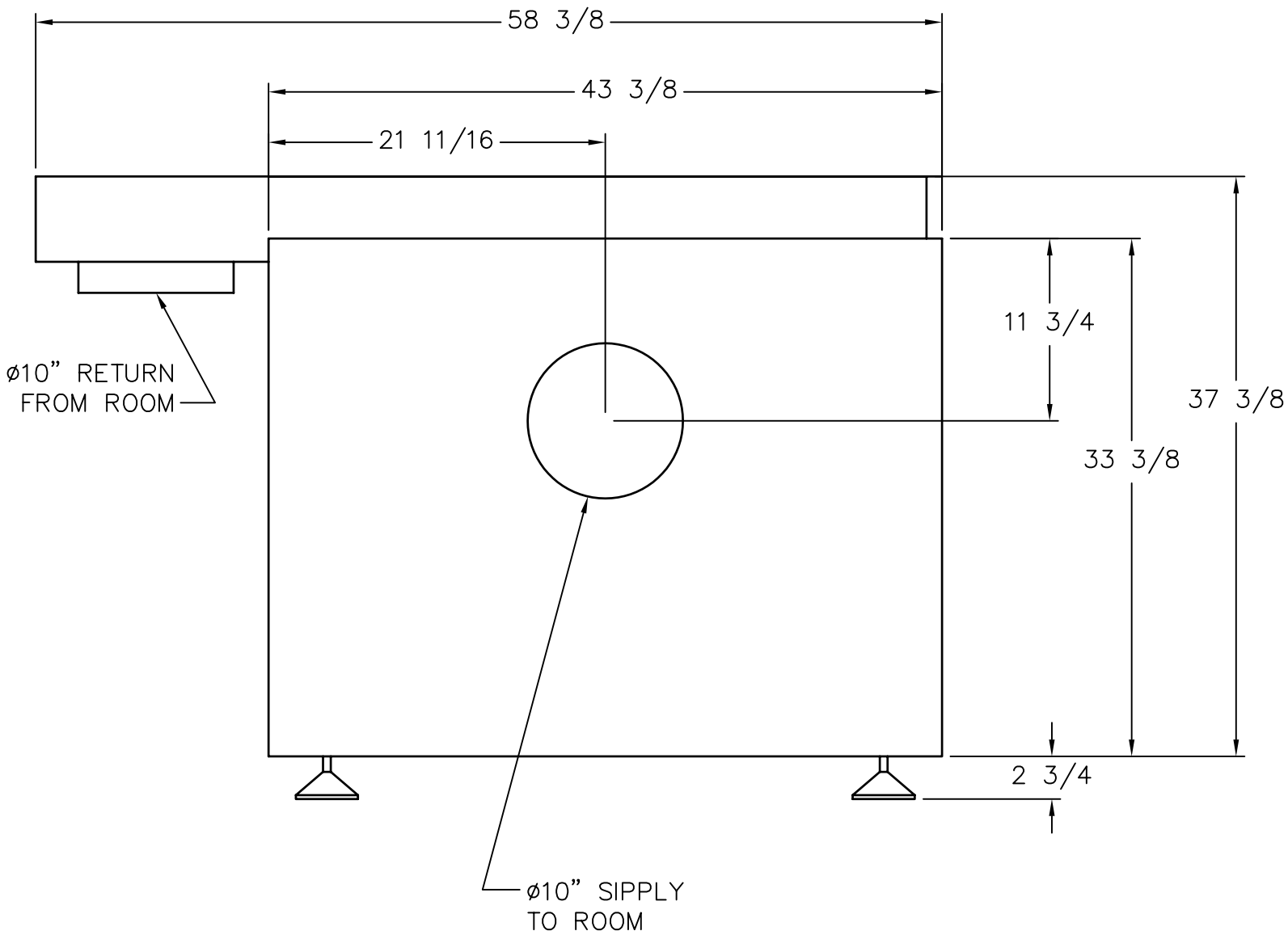
DATE:	DRAWN BY:	
04–14–06	RICK SPERRY	
PART NUMBER: 9354–2150	DWG NUMBER: 9354–2150–03	JOB # JOB#



PARAMETER GENERATION & CONTROL, INC.
(828) 669-8717

TITLE: 500-1000CFM AIR COOLED COND., REQ'D. CLEARANCES

DATE:	DRAWN BY:	
04-14-06	RICK SPERRY	
PART NUMBER:	DWG NUMBER:	JOB #
9354-2150	9354-2150-04	JOB#



PARAMETER
GENERATION
& CONTROL, INC.
(828) 669-8717

TITLE:
500-1000CFM AIR COOLED
CONDITIONER LEFT END VIEW

DATE:	DRAWN BY:	
04-14-06	RICK SPERRY	
PART NUMBER:	DWG NUMBER:	JOB #
9354-2150	9354-2150-05	JOB#